CURRENT SCIENCE

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Madras Fisheries Department.

THE rising wave of prosperity after the worst depression of 1931–32 is recorded in the Director's Administration Report of the Madras Fisheries Department for the year 1935–36, wherein he notes that the year witnessed the revival of important activities which had been suspended. It is indeed a matter of great satisfaction that the Department will now be in a position to demonstrate to the local fishermen the suitable type of craft and tackle to exploit the off-shore fishing grounds, some of which had been discovered by the trawler "*Lady Goschen*" as long ago as 1931. For this experiment a Yorkshire Motor Coble will be used under the direction of Mr. Ritchie as the Master Fisherman in charge. Trials will also be made with the drift, Danish Seine, and American Purse or Ring nets, and their relative utility under Indian conditions assessed. The results of these experiments will be watched with the greatest interest, not only by Madras but also by all other provinces which possess a coast line.

The proposed improvement in the Marine Aquarium at Madras will also give satisfaction to all lovers of nature, and also to those who appreciate the value of such public places as institutions of education in the real sense of the word.

We share the regret of the Director that the value of contributions that Fisheries can make as a source of food supply and wealth to the economic life of the country is not yet realised by the Government of any province. On several occasions we have urged the desirability of creating a Central Bureau of Fisheries Research for the proper conservation and scientific exploitation of the fisheries resources of the country, but no attention seems to have been paid to this problem so far, though an investigation into the whole question of Indian fisheries was promised in one of the meetings of the Advisory Board of the Imperial Council of Agricultural Research, a number of years ago.

A very creditable record of the biological research carried out by the Department is contained in the Report. The presence of animal growth ring in Mackerel scales is now definitely confirmed and it will now enable the assessment of the age of the fish in different catches. Though such investigations are common in Western countries, probably it is for the first time that in an Indian fish an annual growth ring has been definitely demonstrated. The continued research on Oil-Sardine has yielded valuable results which shall have great bearing in forecasting the Fishery of this commercial

species in future years. Here again, the results obtained are comparable to those already known in the case of Herring Fisheries of the Norwegian waters. By far the most creditable piece of research accomplished is to trace the life-history of the most valuable anadromous fish of India, the well-known *Hilsa* of Bengal and the *Palla* of Sind. These researches will no doubt enable in years to come the propagation of the species artificially as is being done in the case of the American Shad.

Through technological research considerable advances have been made in the methods of fish-curing and preservation; in increasing the manurial value of seaweed compositions and in devising means of wood preservation.

Other research items include plankton investigation, fish-marking experiments, hydrographical investigations, pearl fisheries, research on *Gourami*, *Catla*, *Chanos*, and *Etroplus*, etc., etc.

Attention is also directed in the Report to such activities as the supply of Biological Specimens, Anti-Malaria Work, Socio-Economic Work, Propaganda, Fishery Legislation and Publications of the Department. Among publications are mentioned Fish Statistics, Fishing Methods on the Malabar Coast, Bulletin on Pearl Fisheries, Bulletin on Marketable Fish, Trawlers' Report and a report on the brackish water perch *Therapon jarbua*.

In Part II of the Report reference is made to the sound financial stability of the Department which showed a surplus of one lakh of rupees of income over expenditure. In the final part, the Director deals with the Staff and equipment of the Department.

On the whole, the Report, as in the previous years, marks a distinct advance in the development of fisheries in the Presidency of Madras and for this achievement great credit is due to Dr. B. Sundara Raj, the Head of the Department. The working of the Department under great limitations and servere handicaps has demonstrated all the same that fisheries can pay well in this country provided they are properly organised and have a scientific staff to direct and guide the working of the fisheries.

Indian Fisheries.

THE developement of the fishery resources of India is of the greatest importance for the improvement of the health of its teeming millions. In our recent article on 'Indian Fisheries and Japanese Enterprise' (May 1937, 5, 573–77) attention was directed to the present unhappy state of affairs and suggestions were made for its improvement. Our readers will be glad to note that *Nature* in its issue of August 14, 1937, made favourable comments on our editorial and added further details to indicate the gravity of the situation,. Our Calcutta contemporary *Science and Culture* also published an article from Lt.-Col. R. B. S. Sewell, F.R.S., on "Sea-Fisheries in Indian Waters" in its issue of October 1937. Finding a certain amount of awakening of public interest in this matter, we requested Rai Bahadur Dr. S. L. Hora to obtain for us the views of persons who have had first-hand knowledge of Indian fishery conditions and we are glad to publish elsewhere in this issue an article from the pen of Dr. A. W. Herre, formerly chief of the Bureau of Fisheries, Manilla, Philippines. We hope to publish further articles as they become available and later to summarise the views of experts for the benefit of the general public. We take this opportunity to extend to Dr. Hora our sincerest thanks for his valuable co-operation.

Lessons from the Fish Markets of Calcutta.

By Dr. Albert W. C. T. Herre,
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DURING my brief visit to Calcutta last April, I devoted much time to visiting the markets of that great centre of Indian life and activity. All the markets of Calcutta were visited at least once, and some of them were inspected repeatedly. In addition, a number of markets scattered over the Gangetic Delta, were also visited.

In every case the purpose of these trips to the markets was for observing the number and kinds of fishes, both fresh-water and marine, displayed for sale. Specimens were taken of every kind of fish seen, except in the case of a very few large species, too long and bulky to be preserved in any available container.

For a good many years I have been visiting the fish markets of the great rice-and-fish-eating countries of the Pacific Coast of Asia. The principal fish markets along the coasts of Japan, China, the Philippines, Malaya, and the Dutch East Indies are all familiar to me, and in all of them I have seen a large and extremely varied assortment of both marine and fresh-water species of fish.

When one visits one of the largest Calcutta fish markets for the first time he is surprised by the relatively small quantity of fish seen, the limited variety of species exposed for sale, and as a natural sequence, the comparatively high price of fish.

In the markets of Tokyo, Shanghai, Hong Kong, Manila, Cebu and Singapore, one may see vast quantities of both fresh- and salt-water fish, representative of a great variety of species. Any number from fifty to a hundred and fifty species may be seen at almost any time of the year, except during the typhoon season when the range of species may be comparatively limited, owing to the fact that the fishermen are unable to visit their accustomed fishing grounds. In the Dutch East Indies such markets as those of Batavia, Surabaya, Makassar, or Menado are also notable for their quantities of fish and the great variety of species on sale.

In the markets of Calcutta one sees a few high-priced marine fish, shipped in by train from Puri and Balasore. All the rest are mainly fresh-water fishes, with a much smaller number of brackish-water fishes. These are all taken in the rivers, tanks, swamps, and tidal creeks. Apparently in the Calcutta District proper there are no native sea-going fishermen who go out with hook and line, nets, or trawls, to get truly marine fishes. Those fishes which can obtain oxygen directly from the air are brought to market alive, often from very considerable distances. Yet the total quantity of fresh-water fish in the Calcutta markets on any day during the time I was there was evidently totally inadequate to properly feed more than a part of the teeming population. Hong Kong, a city of about 600,000 population, or approximately a little more than a third that of Calcutta, and situated on a rock in the sea, daily receives a larger quantity and greater variety of good-sized to large fresh-water fish than does Calcutta. The markets of Canton abound with a variety of fresh-water fishes, many of which are kept alive very successfully by the ingenious Chinese. The quantity of fresh-water fish daily marketed and consumed in Canton, a city of a million, far exceeds that of Calcutta with a population of a million and a half. As a consequence, the Cantonese and the rest of the natives of South China are well nourished. Any group of people consuming a generous supply of rice and fish is well fed and therefore strong and energetic.

To a considerable degree, the large supply of fish in the Chinese, Javanese and Manila markets is due to the very extensive systems of pond culture developed in China, Java and the Philippines. In China seven or eight species belonging to the carp family are cultivated. In Java carp and gurami, especially the latter, are very successfully grown, so that everywhere there is an abundant supply of fish at a low price. In addition, a great many farmers, and townspeople too, in both Java and South China, have a small pool by the house. In Java these ponds are stocked with young gurami, in China with three or four kinds of carp. The fish are fed on vegetable scraps and grow rapidly. After a few months, a fish can be dipped out whenever the family needs demand.

I introduced gurami from Java into the Philippines in 1927. As soon as the parent stock matured and began to reproduce in quantity, the fry were distributed to people who were in a position to take care of them properly. By 1931 gurami were becoming known to many, and by the end of 1936, gurami ponds were in successful operation in over half of the Philippine Provinces. By the end of another decade gurami will notably augment the food supply of the Philippines.

In addition, the region about Manila Bay is supplied with fish grown in salt water ponds. More than 25,000,000 American dollars are invested in these highly developed ponds, which must be placed where they can be supplied by tides with fresh sea-water. The fry of bangos, *Chanos chanos*, are caught along sandy shores in incredible quantities. These fry are at first placed in nursery ponds, and later transferred to the larger ponds. These fish are vegetarians in diet, and feed on the green algæ which grow naturally in the ponds.

There is another factor which now supplies the greater part of the larger marine fishes seen in such huge quantities in the great fish markets of Manila, Singapore and the Dutch East Indies. I refer to the presence of Japanese fishermen and the great hold they have obtained on these markets.

Politicians and patriots may rave and "point with alarm", but the fact remains, the daring and intensely hard-working Japanese fishermen have supplied a real need. They have caught fish by methods which the native fishermen either could not or would not adopt. They use ocean-going launches, and in some cases trawlers, in their work, while the native fishermen stick to their canoes. It is self-evident that canoes are only adapted to in-shore fishing at shallow depths. As a result of the efforts of Japanese fishermen, the common people have a much greater supply of good edible sea-fish, at a much lower price than formerly, for their sustenance.

The Japanese obtain this supply, first, by using methods unknown to the native fishermen, thereby bringing in excellent kinds of fish not before obtainable in the city markets; and second, by going great distances to catch fish wherever they abound.

As an example, note the manner in which they supply the markets of Singapore. From that city their boats work both the east and west coasts of Malaya. Their boats go northward into the Gulf of Siam, eastward through all the shoals, reefs, and isles of the South China Sea, and obtain a great catch along the western coast of Borneo. They fish the east coast of Sumatra, the islands south of Singapore, the reefs of the Java Sea, the Flores Sea, the isles of the Banda Sea, and even go as far eastward as the Aru Islands, south of New Guinea. No wonder Singapore gets a vast supply of fish at relatively low prices. No matter whether people prefer fresh-water fish or not, if they see an abundance of choice fresh sea fish, at a price which they can afford to pay, they will soon try to supplement their rice. Once having tried it, they will continue to buy.

Since rice and fish are foods which make a well-balanced diet, and since one has but to look at many of the common people of Calcutta to see that they are not properly nourished, it necessarily follows that Calcutta needs more fish and more kinds of fish, and cheaper fish.

The next step is to see what may be done to bring about this desirable, indeed necessary condition. I understand that Bengal has no fisheries department, truly a reprehensible state of affairs. It would seem that with the need for fish and the amount of fish obtained from fresh-water in Bengal, and the vast potentialities of the Bay of Bengal, teeming with desirable food fish, that there should be a strong fisheries department, adequately staffed and maintained. The Zoological Survey has highly competent ichthyologists on its staff, who have specialized on fresh water fish. A fisheries department could utilize their services to great advantage. The fisheries department should also have a thoroughly competent marine biologist and ichthyologist, familiar with pond culture, and with the fishes of the Indo-Pacific waters. Above all, the department should be administered by a scientific man, and not a clerk. More than one scientific governmental project has been wrecked by placing a clerk at the head as administrator. No matter how laudable his intentions, he is necessarily incompetent to pass on matters or formulate policies so remote from his previous environment and training.

I suggest that the improvement of the Calcutta supply of food fish be undertaken along lines somewhat as follows:

First, the establishment of a fisheries experiment station. Here a study should be made of pond culture under Indian conditions.

A. Brackish-water ponds should be constructed along tidal creeks and the culture of bangos (*Chanos chanos*) and mullet attempted. In this connection it is well to note that Sir Francis Day says (*Fishes of India*, 1878–88, p. 651) that *Chanos chanos* was introduced into both fresh and brackish-water tanks in South Canara by Hyder Ali. He also stated that these tanks still contained this fish. There is, therefore, little doubt that *Chanos chanos* will thrive in India, wherever properly cared for.

B. Fresh-water ponds should be developed for the culture first, of native carps; second, of various Chinese carps; third, and probably most important of all, gurami.

C. The study of the fishes of the Bay of Bengal should be intensified and amplified. The distribution and relative abundance of food fishes in the Bay of Bengal should be known.

Second, the development of trawling and other methods of off-shore fishing should be vigorously encouraged. If local capital cannot be interested in such projects, fall back on the Japanese fishermen, and let them supply in part the hungry millions of Bengal. Already, I understand Japanese trawlers are at work in the Bay of Bengal. On my recent visit to Rangoon, the markets gave evidence of the activity of Japanese fishermen.

If the Government were to back such projects properly, grant licenses to Japanese with regulations and restrictions concerning the employment and training of Indians, and otherwise safeguard the embryonic industry, it would lead in time to a fleet of modern fishing vessels manned and controlled by Indians.

The open sea is available to any or all nations with men and ships. Japanese, or fishermen of any other country, are therefore free to fish in the Bay of Bengal outside territorial waters. They should be allowed to dispose of their catch in Calcutta, and thus benefit the general run of fish consumers. If they are not allowed to do this, they will dispose of their catch in Rangoon, Singapore, and even ship the more desirable kinds back to Japan.

But it is not an unmixed blessing to have any great industry or source of food under the control of aliens, living in and owing allegiance to another country. However, it would do no harm, but would be a public benefaction to allow the development of a new industry in a country by aliens, if, at the same time, a body of citizens was trained and financed to take over the bulk of the industry ultimately.

Third, before anything else is done *in re* marine fisheries, arrangements should be made for the proper distribution and marketing of the fish obtained. These require an abundant supply of cheap ice, and ample cold storage facilities. The logical agency to supply such need is, of course, the Government itself. There is no great public service rendered if the catch is brought in half putrid or even just stale, and then left to haphazard devices or agencies to get it to the consuming public.

Fourth, there should be no false ideas about having a fishery department "pay its own way". We are dealing with a food supply necessary for supplying protein to rice-eating populations, with vast potentialities of increase in quantity and reduction in cost. To feed the people is a necessity and a fisheries department should no more be called on to pay its way, or show a profit, than to expect the public health service to get rich from epidemics. For example, to successfully introduce the culture of gurami into India, and thus augment the food supply of generations to come, would add untold lakhs of rupees to the wealth of India. This would be true even though it cost the Government many thousands of rupees, and the fry were distributed *gratis* until private individuals had bred ample stocks, sufficient to meet all demands.

There is no question that the Government of Bengal needs to develop fisheries, marine as well as fresh-water. This can only be accomplished by long-time planning. A programme should be laid out for ten years ahead and for twenty-five years, and every effort made to carry out the plans outlined. The plans should be drawn up by the best trained scientists, with long and successful experience, and a scientific man of broad training and experience should be placed at the helm to see that they were properly executed. He should, likewise, be authorized to amend, amplify, or otherwise adapt the programme to meet changing conditions, public prejudices, and other deterrents of such character as to be unforeseen.

Coal Industry and the State.*

By M. S. Krishnan.
(*Geological Survey of India.*)

THE world's production of coal in 1929 was around 1,560 million metric tons. It went down in 1932, the worst year of the depression, to 1,124 million tons and it has not yet attained the 1929 level. The current year may bring about complete recovery, seeing that a great stimulus has been given to the metal industries by intensive war activity in several of the most important countries of the world. The depression was shared by practically all countries, even by those whose currencies had depreciated, except perhaps in the case of the Soviet Union.

Since the last War vital changes have taken place in the ideas of individuals and nations in various directions. One of these is the relationship between private or company-owned industry on the one hand and the Government as representing the nation on the other. In the case particularly of the basic industries, the Governments of many countries have realised the need for co-ordination, supervision and control, and have put a stop to the individualistic *laissez faire* policy of former days. The coal industry presents an example of governmental control even in countries where private enterprise has the fullest freedom of action. It is proposed in this note to present a few salient facts regarding the organisation of the coal industry in a few important coal-producing countries. The information and figures given here have been taken mostly from papers presented before the third World Power Conference held at Washington D.C. in 1936, occasionally supplemented from other sources.

At one end of the picture is the Soviet Union where all sources of production, and agencies of distribution entirely belong to and are controlled by the Government. Whether the degree of co-ordination claimed has been achieved is a question the correct appraisal of which is difficult, because of the usually violent partisan attitude of most of the observers who have written about that country. At the other end are countries where all industries are run by private interests which are often powerful enough to control governmental policies. There are various stages in between these. As remarked above, the tendency of governments to control industry is now very evident in most countries, though the method of approach and the manner of achieving the control differ considerably.

Germany.

There has been some measure of control in the German coal industry for several decades past. The coal industry can be conveniently considered under two heads, bituminous coal and brown coal.

Proved resources of bituminous and higher rank coals in Germany, to a depth of 1,000 metres, are 87,330 million tons. Probable resources, to a depth of 2,000 metres, are estimated at 288,000 million tons. Of this total, 74 per cent. is said to be in the Ruhr area, 18 per cent. in Upper Silesia, 3·5 per cent. in Aachen, 3·2 per cent. in the Saar basin and 1 per cent. in Lower Silesia. Stated differently, 23 per cent. of the proved resources is semi-bituminous to anthracitic, 35 per cent. bituminous coking and 21 per cent. open burning long-flame coal and 21 per cent. gas coal.

In German mining law the ownership of surface is mostly divorced from the right to the mineral underground. The State has reserved for itself, in some areas, the rights for certain important minerals, *e.g.*, coal and salt. The mining regulations control safety and health of the workers, insist on support to the surface over mining areas and safeguard public welfare. Specific rules are in operation for the use of explosives and electric installations particularly in 'fiery' mines. The Provincial Mining Authorities have charge of making regulations to suit local conditions of mining. The mine operator has to submit plans of operation to the State Authorities and may proceed to mine if no objection is raised within fourteen days.

The State-owned mines contribute an important part of the output. Their share in the total production was over 17 per cent. in 1935, *i.e.*, 23·7 million tons out of a total

* Published by permission of the Director, Geological Survey of India.

of 112·5 million tons. This includes 100 per cent. in the Saar area, 80 per cent. in Lower Saxony (Hanover) and 8·6 per cent. in the Ruhr District.

The original form of enterprise in Germany, the "cost-book" company (bergrechtliche Gewerkschaft) is now superseded to a large extent, though in some districts it still accounts for 25 per cent. of the output. The stock company or "Aktiengesellschaft" is the most important in all the fields, though in Saxony and Upper Silesia the limited liability company has attained importance.

The earliest effort at control was made in the Rhine region, after several years of fluctuating prices and speculative mining activity, through the establishment in 1893 of the "Rheinisch-Westfalisches Kohlensyndikat" for price control and for ensuring stability in production. This was a co-operative voluntary organisation, on which was founded the State Law of August 23, 1919. District organisations were thus introduced which were members of a more general regional organisation and in which workers had representation. They regulated output and sale under the superintendence of the Coal Council (Reichskohlenrat). The Coal Council had 60 members, of whom 18 were workers' representatives and 13 consumers' representatives. The Trusts in the different mining districts were consolidated into a general coal organisation (Reichskohlenverband) in which both workers and consumers were represented. Under the law, this had supervisory powers over the District Trusts, especially in the matter of price control. The Coal Council had powers of approval over company contracts and could prevent uneconomic competition. By the Coal Mining Law of April 21, 1933, the Coal Council was dissolved and its powers assumed by the Reichsminister of Economy, who is virtually a dictator.

Since the War, the coal industry has had to meet increasing taxation and financial burden which was possible only through the reduction of operating costs by mechanisation and the consolidation of working units. The rationalisation scheme has been extended from the mining to the processing and manufacturing fields. Even in the year 1924, there were only 376 mining units and the number has been since reduced to 224 in 1934. In 1924, there were 6 mines with an output exceeding one million tons per year, and the number has steadily increased to 26 in 1934. Extensive mechanisation has enabled the output per man-shift to be increased by 60 per cent. between 1926 and 1935 (in Upper Silesia from 1670 kg. to 2435 kg. per man-shift).

In transportation, coal enjoys specially low railway freights which aid it to compete with foreign coal even when the haulage is long. Special tariffs are in operation for special areas or particular industries which suffer from handicaps (*e.g.*, domestic lead-zinc ores or Siegerland iron ores, etc.).

German Brown Coal.—The lignite industry of Germany is independent of the bituminous coal industry and is organised separately. Lignite is worked in open-cast quarries. The production in 1933–34 amounted to 147 million metric tons of which 33 million tons were pressed into briquettes. About half of the raw brown coal is consumed by electric power plants and over 20 per cent. by the chemical industry. Nearly 74 per cent. of the briquetted brown coal was used for household heating and for agricultural purposes. The available reserves (*i.e.*, excluding that under towns, canals, railways, etc., and also allowing 10 per cent. waste for surface mining and 35 per cent. for underground mining) have been calculated at 56,758 million tons.

The ownership of the brown coal deposits belongs to the State in some areas and to the surface owners in others (Prussia, Saxony, Hanover, Silesia). In Saxony, the State assumed the ownership of coal in 1919, except in the case of the mines actually working. Under the law of 1924, the mining rights for brown coal in Hesse-Nassau, Brandenburg, Saxony, Lower and Upper Silesia were reserved to the State. In other districts, however, private companies have the freedom of acquiring properties.

Under the Mining Law of February 28, 1935, all matters relating to mining come under the Supreme Authority of the Reichsminister of Economy. He is empowered to interfere on behalf of public welfare and safety and to control and fix selling price. The brown coal industry is controlled by three regional syndicates: Central German Brown Coal Syndicate with headquarters at Leipzig, East Elbe Brown Coal Syndicate at Berlin and Rhenish Brown Coal Syndicate at Cologne. There is also a local syndicate in Bavaria. The duties of the syndicates include regulation of output and the consumption and sales to their members. The

maximum prices are fixed by the Reichsminister who exercises powers of supervision and control. The syndicates sell to wholesale and retail dealers who have fixed areas for sale. The syndicates have agreed prices in overlapping areas and in areas where they compete with bituminous coal. The duties and rights of the members are defined in detail, and they are under discipline; they are liable to penalties or expulsion if they infringe the rules.

Belgium.

In Belgium the minerals belong to the surface owners but operators have to get a licence from the State which submits the applications to the Mines Council. Fixed royalties are paid on areas and on the net proceeds. Concessions may be ceded or transferred only with the permisison of the State. The properties are generally leased in perpetuity.

France.

France is estimated to contain about 20,000 million tons of workable coal. The coalfields are situated in the northern and north-eastern part of the country and also along a N.-S. line through the middle, the fields being called the 'Pas de Calais and Nord', 'Lorraine', and 'Centre et Midi'. The annual production averages 47 to 50 million tons of which 30 per cent. is good bituminous coal, 40 per cent. shaley high volatile coal and the rest semi-bituminous dry coal. The seams are rather difficult to mine, on an average 3 ft. thick, and at depths of 1,200 to 1,500 ft.

Minerals are governed by the law of April 21, 1810, by which the State gives concessions to individuals and corporations to work coal in the areas specified. Originally, this gave perpetual rights to the lessee with power to transfer it as property, but by the law of September 9, 1919, new concessions are granted for 99 years, a condition being that the State is entitled to excess profits ranging from 10 per cent. to 75 per cent. There is a tax on mines, which was in 1934 nearly 9 francs per ton of coal raised, *i.e.*, nearly 11 per cent. of the pit-mouth value of coal. The Mines Department has rights of supervision and control of the working methods.

There are no State mines. There are about 100 coal-mining companies, the average production per mine being about half a million tons per year.

Until about a decade ago the individual producers were left to themselves. In 1928, the necessity for price regulation led to the formation of the Sales Company of Lorraine coals (Charlor). It is the recognised selling organisation in a number of Departments. The "Comptoir Commercial des Houillère du Centre et du Midi" was formed in 1935. The "Comptoir d'expansion Commercial des Mines du Nord" has been reorganised and the three organisations have, by agreement, divided the markets amongst them from 1932. The country is divided into certain zones for sales purposes and the groups have adopted the percentage of sales in 1929–30 as the basis. If one group exceeds its percentage, a money payment is made to the group which is in deficit. Certain zones are also marked as special areas for each group in which the particular group can exceed its sales quota without paying the others. This arrangement has been functioning satisfactorily. For the purpose of control of this agreement an "Office of Coal Mining Statistics" has been formed. In case of dispute between the different groups, this Office refers the matter to an expert or to an arbitrator for decision.

France produces only about 70 per cent. of its requirements, the rest being imported. France imports about 30 to 40 million tons of coal per year, the import being regulated since 1931 by licence on which there is a tax on a tonnage basis. The licences are regulated under quotas for different countries from which the coal is imported.

Holland.

In Holland the State mines produce nearly two-thirds and the private mines one-third of the total output. The surface rights are separate from underground mineral rights. The State mines operate in much the same way as private companies, none of the employees in the mines being State officials. The only point of difference between these and private mines is that the capital is State capital.

There is a Council of Mines which advises the Minister of Mines. Except for Russia, Holland seems to have been the only country in Europe in which coal-mining suffered little during the depression.

Czechoslovakia.

The mineral rights in Czechoslovakia belong to the State and are leased out by

the State. The mines can be sold, transferred and mortgaged by the lessees with the consent of the State.

The State now operates a number of mines and was responsible for 4·5 per cent. of the output of bituminous coal and 12·5 per cent. of output of lignite out of a total production of 10·7 million tons of bituminous coal and 15·2 million tons of brown coal, in 1934. The mines have to pay 10 per cent. of the selling price of coal as tax. The State is empowered by law to regulate prices. There are sales organisations for the different districts, who control most of the output. The competition between the different districts is also under control.

Hungary.

As in Czechoslovakia, coal was a reserved mineral which belonged to the State, but since 1861, the rights passed on to the landlords. Working of the mines and the production are controlled by the mining authorities. Since 1932, the price is controlled by the "Price Analysing Committee," who fix it according to calorific value and freight. The Government fixes the price for lump coal and for briquettes.

China.

The coal reserves of China amount to 250,000 million tons of which 79·3 per cent. is bituminous, 19·3 per cent. anthracite and the rest (*i.e.*, 1·4 per cent.) is lignite. Shansi and Shensi contain about 80 per cent. of the total reserves. 75 per cent. of the present production of China proper (total 21 million tons) is bituminous coal. At the end of 1935, the coal areas leased out amounted to 15·68 million hectares, and the areas under Government operation 0·6 million hectares. In addition to a small rent on the basis of the area of the concession, there is a production tax of 5 per cent. of the sale value of the coal produced. The industry is run by Chinese and foreign capital, 68 per cent. being Chinese capital, 18 per cent. Japanese and the rest European.

A new mining law was promulgated by the Nankin Government in 1930, under which all mineral wealth belongs to the State. The surface owner has no underground rights. Licences for prospecting and mining are granted by the State, prospecting for 2 years and mining for 20 years, which may be extended for two periods of 20 years each. The working of coking coal is reserved to the State. In exceptional circumstances, however, if the State considers the areas or mines inoperable by themselves, the mines may be leased out to private companies. Plans for sales quota and limitation of the sales areas for groups of mines have been under consideration for some time.

Japan.

The coal resources of Japan are estimated at 18,000 million tons, and the country's annual production is about double that of India, mainly from Kyushu and Hokkaido, which necessitates rail and ship transport. The transhipment is now done to a large extent mechanically and considerable attention has been paid to standardisation of waggons and equipment for handling coal.

The Government Railways are large consumers of coal, the annual consumption being about 4 million tons. Coals of different qualities are used and often several different kinds are mixed for use in locomotives. For dometsic consumption, briquettes are becoming popular, particularly with a view to eliminate smoke. The total coal consumption of Japan amounted, in 1935, to 38·7 million tons of which 2·6 million tons went for bunkering purposes, about 4 million tons for railways and over 6 million tons for heavy industries and 4 million tons for cotton spinning industry.

In recent years, considerable advance has been made in the control of the coal industry on a voluntary basis. Quotas for production are assigned by the Coal Mining Union on the recommendation of the Showa Coal Company, which ascertains the market demand and is also the sales organisation. Excess production by any colliery or company is penalised by an impost of 2 yen per ton. Special quotas are in force for bunkering and export purposes. In the case of the minor producers the controlling agency is the Chiku-Ho Mutual Aid Association. These organisations control more than 80 per cent. of the total Japanese output.

South Africa.

South Africa is an important coal producer in the sea-board of the Indian Ocean and is of particular interest to India as her chief competitor in the domestic and foreign markets. The total production of South Africa is around 13 million tons, the two chief coal areas being in the Transvaal and Natal. The output of the former is more

than double that of the latter, but Natal exports nearly half its output. The "Transvaal Coal Owners' Association" fixes quotas of production, buys all the coal produced by its members and sells it in the market, about 80 per cent. of the Transvaal production being disposed of through it. There are two bodies in Natal, the "Natal Associated Collieries" which is the sales organisation for internal trade, and the "Natal Coal Owners' Association" for the bunker trade. There are quotas for internal and bunker trade but not for export. Hence the export trade is keenly competitive, but is helped by cheap railway freight.

There are organisations for the recruitment of native African labour. In the Transvaal this is done by the Witwatersrand Native Labour Association, mainly from Portuguese East Africa. The wages of an African miner averages 40*s*. to 60*s*. per month and includes housing and rations, whereas the average wage of European labour is 24*s*. in Transvaal and 21*s*. in Natal per shift. Indian labour is also employed at slightly higher rates than the African.

The Government does not regulate the industry except in so far as safe methods of working and the grading of coal for export and for the bunker trade are concerned. Those participating in this trade are compelled to have a grading certificate as in India. In fact, the India Coal Grading Act of 1925 seems to have been modelled on a similar Act of 1922 of South Africa. Export trade is helped by a specially low railway tariff. For instance, the railway rate for export-coal from the Natal coalfield to Durban, over a distance of 275 miles, is 5*s*. 9*d*. per ton, whereas for the same distance for inland markets the rate is about 12*s*. 6*d*. The railway rates from the Transvaal (Witbank) coalfield to the Rand Goldfield is 8*s*. per ton, though the distance is only 100 miles. For long distances for inland trade the rates are on a sliding scale—16*s*. 10*d*. for 500 miles, 20*s*. 4*d*. for 750 miles and 23*s*. 6*d*. for 1,000 miles.

Under the Fuel Research and Coal Bill of 1930, the Government have powers to restrict export when necessary and to compel sales of coal at reasonable prices for railways and ports. Fuel research is under the control of a Board to which a chairman and two members are nominated by Government, and two members are elected by the industry. The capital cost of the Institute was met by the Government. The annual expenditure is met by a levy not exceeding ¼*d*. per ton on all collieries raising more than 25,000 short tons per year, an equal amount being contributed by the Government.

Great Britain.

The ownership of coal in Great Britain is vested in the owners of surface lands who lease out the underground rights of the coal areas separately from surface rights. Sometimes lessees hold the rights for both the surface and sub-surface. The distribution of coal is in the hands of wholesale and retail merchants.

The first attempt at general control of the coal industry was made by the Government in 1930 when they passed the Coal Mines Act. This Act was to be in force till 1932, but was later on extended to the end of 1937. It empowered the Government to encourage voluntary amalgamation and also to enforce such amalgamations where uneconomic units were working in wasteful competition. As a result, the number of mines has been reduced from 2,861 in 1927 to 2,075 in 1935 though this was done with considerable difficulty. About 90 per cent. of the output of the country is said to be controlled by about 150 undertakings each of whom operates a group of mines. Even now the potential capacity is said to be 25 per cent. above the present output.

The coalfields have been divided into districts, each district with a controlling authority elected from the local mine-owners. This body fixes quotas for the output of different mines, taking all the varying factors into account. The minimum price for the different classes of coal in each district is also laid down. But the quota and price may be varied from time to time, according to market conditions.

There is also a central authority to determine the production of each district and to co-ordinate the activities of the different districts. Committees have been set up in which the owners, miners and consumers are represented, for providing an arbitration machinery to look into complaints. Export quotas are separate from those for inland consumption.

The opinion of competent observers is that price control has been much more difficult than production control. There are not only technical difficulties in

establishing and maintaining prices for different classes of coal, but in a keenly competitive market there are easy ways of evasion of price control.

Central Selling Schemes have since come into operation, in which the producers no longer sell thair coal direct to the consumers. The central organisation purchases the coal and distributes it. To avoid much dislocation in the trade, the producers' salesmen have become the servants of the Central Sales Organisation. The profits and losses of the transactions as a whole are distributed on a tonnage basis. This scheme has been able to put a stop to competition between different mines and different districts, and also to bring some pressure to bear on large consumers like railways and industries to pay reasonable prices for the coal they purchase.

The Royal Commission on the Coal Industry of 1925 found that one of the major defects of the industry was the ownership of coal by private interests and recommended that the Government should acquire the royalty rights from the present holders on payment of suitable compensation. The Government appointed a Tribunal in March 1937 to determine the purchase value of the royalty rights and have since accepted the valuation £63,500,000 recommended by the Tribunal. It is learnt that legislation is now being put through the Parliament to enable the Government to acquire the royalty rights.

The need for systematic research on coal was felt during the War, and a Fuel Research Board was set up in 1917 with a central laboratory in London. A national coal survey was organised in co-operation with the Geological Survey, and regional laboratories were established in each of the nine major coalfields. In addition to routine analyses and tests carried out in all the laboratories, the central laboratory undertakes research in carbonisation, coal-cleaning, combustion, hydrogenation, pulverised and colloidal fuel, etc., and also in some of the fundamental problems of coal technology.

United States.

As in England, the ownership of coal in the U.S.A. vests in the owners of the surface lands. Only in Alaska and some of the Western States have some unsettled areas been declared to be 'public domain', where leasing is done directly by the Government by public auction. The dead rent is fixed at 25 cents per acre for the first year, 50 cents for the second year and 1 dollar for each succeeding year. In addition, a royalty of 5 cents to 15 cents, depending on the quality of coal, is charged per short ton of output.

All the coalfields of the east and mid-west belong to private owners. Here the conditions of lease as well as of royalties vary greatly. The royalty on bituminous coal averages 12 cents per ton (range from 7 cents to 25 cents) and that on anthracite averages 45 cents (range from 25 cents to 1 dollar) per short ton. In these areas the State has jurisdiction over only the health and safety of the workers.

The coal reserves (original content) of the U.S.A. to a depth of 3,000 ft. as calculated by the U.S. Geological Survey, are shown below:—

	Million metric tons
Anthracite and semi-anthracite	19,820
Semi-bituminous	51,309
Bituminous	1,250,127
Sub-bituminous	742,453
Lignite	852,203
TOTAL ..	2,915,912

The maximum annual production (in 1929) was 552 million metric tons.

During the last few years attempts have been made to bring the industry under Government control. The National Industrial Recovery Act (N.R.A.) of 1933 strove to establish an organisation in each district for the control of production and prices, and a National Coal Administrator was appointed to co-ordinate the activities of the districts. This Act was thrown out as unconstitutional by the Supreme Court. The Coal Conservation Act of 1935, which aimed at price control by a commission of five men appointed by the President, also met with a similar fate at the hands of the Supreme Court.

Canada.

The annual production of coal of the Dominion of Canada is only about 14 million tons a year, of which 10 million tons are bituminous coal and practically all

the rest lignite. The latter is produced in Alberta, Saskatchewan and Ontario.

The Dominion Government has control over only Yukon and North-West Territories. In other provinces the ownership of the minerals belongs to the State in public lands and in areas not settled before 1887. Each Province has its own laws about leasing and tenure. In general, leases are for a period of 20 years with option of renewal for two or three like periods. The State and Dominion Governments control safety in mines but not output or prices. Special railway rates or rebates operate facilitating equal competition in markets by different producing regions. A bounty was also in force to help the use of Canadian coal in low temperture carbonisation plants.

Research in many phases of fuel problems is being conducted by the Federal Department of Mines, the Ontario Department of Mines and the Research Council of Alberta.

The foregoing particulars will show that many countries have adopted measures for the control of the coal industry in all its phases—production, prices and distribution. The elimination of waste is an essential part of such control. This is achieved mainly through research institutes financed and directed by the State with the cooperation of all the interests concerned. A number of rich and influential private organisations also conduct researches, but they differ from the State institutions in that the problems are generally of limited interest and the results are not available to the industry as a whole. This note will, it is hoped, serve to focus attention on what is being done in other countries, so that India might benefit by their experience in the solution of her own peculiar problems.

Water Requirement of Crops.

By V. A. Tamhane, M. A. Shama Iyengar and J. J. Chandnani.
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THE construction of the Lloyed Barrage has brought very vast areas under irrigation and one of the most important problems in irrigation agriculture is the relations of the irrigation water to the crops on the one hand and to the soil on the other. All the older irrigation schemes have taught that a careful use of water is vital for the continued productivity of irrigated lands. The dangers of the misuse of water in Sind are twofold, *viz.*, the possible rise of the water-table and the development of salt lands. Hence it was necessary to determine the "Exact water requirements of the different crops" in the area, which resolved itself into the following items for investigation:—

The minimum quantities of water neeed to produce normal yields of the more important crops;

The mode of distribution of a given delta (total quantity of water) during the life of a crop;

The economics of a larger or smaller supply of water than the optimum;

The effects of different delta given on: (i) the soil and (ii) the plant performance; and

The optimum soaking doses.

The results of some of these investigations are recorded below:—

Sind is a land of extremes of temperature, with an average rainfall of less than 4 inches per year. The soil is a deep calcareous alluvium and the irrigation water is good.

Under these conditions of climate and soil, a series of experiments were conducted over a period of seven years. The experimental plots were levelled to perfection to ensure an even distribution of water in each plot and the water given at each irrigation was measured accurately. The plots were of uniform size of one *guntha* each and in the case of cotton, all the plots were thinned to grow nearly equal number of plants. The number of replications varied according to the number of treatments in the several years but was never less than four. The lay-out was always randomised.

Optimum Amounts of Water.

Duties of 100 for *kharif* crops and 200 for the *rabi* crops were taken as standard for purposes of comparison as recommended by the Baker Lane Report—duty meaning the number of acres of a crop which could be brought to maturity with one cusec discharge of water.

These experiments were conducted with two varieties of cotton and two varieties of wheat and the following are typical of the results obtained.

TABLE I.

	Yields in lbs. per Acre						
	Cotton 289 F				Wheat Pusa 114		
Duties	80	100	120	150	160	200	240
Water given in acre inches	46·5	37·2	31·0	24·8	18·0	14·4	12·0
Yields in							
1930	2760	2440	2280	..	..	..	..
1932	1120	640	..	280	1600	1240	1200
1933	1840	1520	..	1360	492	1006	640
1934	920	840	640	720	1080	1040	820

The 1932 season was unfavourable to cotton.

Examination of the data has shown conclusively that normal yields can be obtained with a duty of 100 for cotton and 200 for wheat. Larger supplies of water result in giving larger yields but these increases are statistically insignificant and are not economical.

JUDICIOUS IRRIGATION.

It has been the general practice to water all crops at certain regular intervals both because of convenience and the availability of water. But plants are known not to require identical quantities of water in the soil during all the different stages of their growth. In an experiment, therefore, certain crops were irrigated not at any given intervals but only at such times when they were in need of it, of which the moisture content in the soil was taken as the index. Accordingly, the crops were irrigated only when the moisture in the soil decreased to a given percentage, in this case 5 per cent. which was arbitrarily 1 per cent. over the calculated wilting coefficient. The yields of cotton and wheat obtained were:

TABLE II.

Crop	Total water in acre inches	How given	Calculated Duty	Yield per acre in lbs.
Cotton	36·7	As usual (at 15 days' fixed intervals)	100	568
	37·1	Judicious (with soil moisture as index)	98	840
	45·9	As usual (at fixed intervals)	80	820
Wheat	14·4	As usual (at 30 days' interval)	..	1080
	13·5	Judicious	..	1100

The judicious administering of water is indeed profitable in cotton and for a given amount of irrigation a distinctly better yield is obtained. In fact, the yield obtained with 37·1" of water given judiciously is as good as that got with a delta of 45·9" water given at the usual regular intervals. Wheat however, did not respond to this treatment.

These experiments have shown that:—

(i) plot duties of 100 for cotton and of 200 for wheat are the optimum, and

(ii) the cotton is definitely benefited by a more intensive supply of water during the later stages of its life as compared to an even distribution at equal intervals of time.

OBITUARY.

Sir Jagadis Chunder Bose, F.R.S.

SIR JAGADIS CHUNDER BOSE died at Giridih, of heart failure, on the 23rd of November 1937. He was born on the 30th of November 1858. He graduated in the University of Calcutta from St. Xavier's College, Calcutta (1880) and then took the Tripos from Christ's College, Cambridge, and B.Sc., London (1883–84). On returning to India in 1884–85 he was appointed Professor of Physical Science in the Presidency College, Calcutta. This connection he held to the last with the unique distinction of Professor Emeritus after his retirement from service in 1915. Most successful as professor, he was indefatigable as an investigator from the very beginning of his career. His first original contribution was communicated to the Asiatic Society of Bengal, 1st May 1895: "On Polarisation of Electro-Magnetic Waves". In 1895 Prof. Bose was awarded the D.Sc. of London for his original researches.

Sir Jagadis Chunder Bose, F.R.S.

For the next seven years, his papers were published in the *Proceedings of the Royal Society of London* and many of the Scientific journals all over the world. He was the discoverer of Crystal Receivers and his work on self-recovering receivers and allied phenomena upset the coherer theory then in vogue. His observations on the *fatigue* of receivers led him to investigate the similarity in the response curves of muscular tissues and inorganic matter. His investigations led him to ask himself the following question: "If there was so much of similarity in the responsive curves of the non-living and the living matter, then how much more than mere similarity was to be expected in the animal and the plant life? Might not there be the underlying identity in the animal and plant mechanism, and would it not be possible to unravel many of the intricacies of the more complex life phenomena in the animal by studying the simpler and more easily controllable phenomena in plant life?"

Sir Jagadis felt the necessity of a well-equipped laboratory to investigate these phenomena and with this in view, he established the Bose Research Institute, of which he was the Founder-Director. The Temple of Science he dedicated to God for the good of the world and to the glory of India (November 30th, 1917).

For study in the new line of work, Sir Jagadis had to devise and construct his own instruments. His Resonant Recorder, High Magnification Crescograph, Magnetic Crescograph, Balanced Crescograph, Plant Sphygograph and Photosynthetic Recorder are only a few of his numerous inventions embodying new principles and surpassing in magnification and precision all previous instruments for similar research.

He was elected a Fellow of the Royal Society of London in 1920. Of academic honours bestowed on him both in India and abroad there are so many; it may almost be said that he had them all. He was the recipient of fellowships and memberships from scientific societies from all over the world. They are too numerous to enumerate. The Government of India bestowed on him the C.I.E., C.S.I., Kt., and other distinctions. Sir Jagadis was also appointed a Member of the International Society of Intellectual Co-operation of the League of Nations. His Majesty the late King of the Belgians honoured him by awarding the Legion of Honour. He was a past President of the Indian Science Congress.

He leaves behind him his widow Lady Bose, second daughter of the late Mr. D. M. Das of Calcutta High Court, and Sister of the late Mr. S. R. Das and of Mr. Justice Das of Rangoon.

N. C. N.

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Two Recent Earthquakes in North-West India.

After the disastrous Baluchistan (Quetta) earthquake of May 31st, 1935, India has been free from any large seismic disturbances, but two earthquakes of more than average intensity occurred within the last two months. The first of these occurred on the morning of October 20th at 6 hrs. 54 mts. I.S.T. It was of moderate intensity (not more than 7 on the Rossi-Forel scale) and was felt over the Punjab-Kumaon Hills and over a considerable part of the East Punjab. From the seismographic records obtained at the observatories of the India Meteorological Department, the position of the epicentre could be located as being near Dehra Dun. The last really severe earthquake which occurred in the neighbourhood of the present focus was in 1803.

The second shock occurred on the afternoon of November 14th at 16 hrs. 28 mts. and its epicentre as provisionally determined from the seismic record of the India Meteorological Department was in the Hindu Kush Mountains near 37°·3 N., 72°·0 E. This was of more severe intensity than the Kumaon shock, but there were no very disastrous effects, mainly because the focus of this earthquake was not near the surface but was about 200 km. deep. Deep-focus earthquakes do not generate the same large amplitudes of surface waves as shallow quakes do. Still, the present earthquake was felt over a considerable part of the North Punjab, the North-West Frontier Province and Kashmir. Damage to buildings and injuries to a few persons from falling debris have been reported from Chitral and Kashmir. It is interesting to note that the focus of the present earthquake is very near the foci of nearly a dozen earthquakes which have occurred during the last few years, all of which had a depth of 200 to 250 km. The Hindu Kush is the only region in the immediate neighbourhood of India where deep-focus shocks have been shown to occur.

Fig. 1 shows the N–S component of the seismogram of the earthquake of November 14th, recorded at the Colaba Observatory, Bombay. The large amplitude of the P and S waves, the comparative weakness of the L waves and the appearance of shear-waves reflected from the core of the earth (S_cS) may be noted. About a minute after the beginning of the preliminary waves, there is a sudden increase of amplitude which is due to the arrival of waves (sP) reflected from

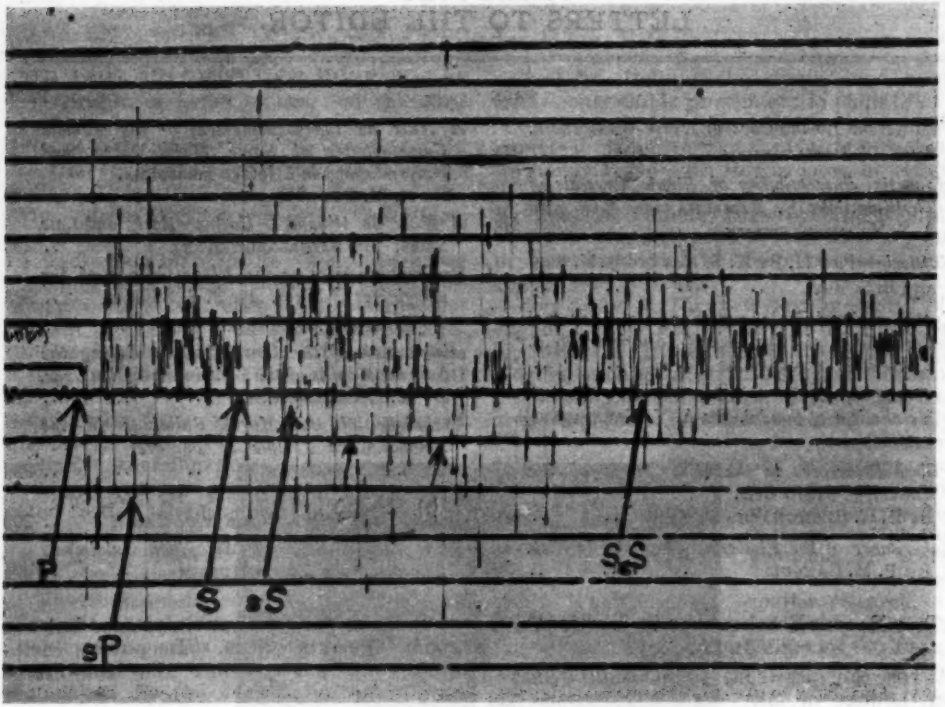

Fig. 1.

The seismogram of the Hindu Kush Earthquake of November 14th, 1937, (N.—S component), recorded at the Colaba Observatory, Bombay. The impulsive beginning of the preliminary waves was recorded at $16^h\ 32^m\ 05^s$ I.S.T.

the earth's surface near the source. From the differences between the time of arrival of these waves and that of the preliminary tremors, the depth of focus can be judged.

K. R. RAMANATHAN.

Colaba Observatory,
Bombay,
November 29, 1937.

Magnetic Susceptibility of Single Crystals of Thallium.

THE magnetic susceptibility of single crystals of thallium was studied recently by Rao and Subramaniam.[1] They obtained for the principal susceptibilities of the crystal parallel ($\chi_{\parallel}$) and perpendicular ($\chi_{\perp}$) to the hexagonal axis the values $-0{\cdot}412^2$ and $0{\cdot}165$ respectively. This gave for thallium the average susceptibility of $-0{\cdot}247$ and a magnetic anisotropy of $2{\cdot}50$. These values were obtained at room temperature. It was found on heating the crystals that at 235° C., the susceptibility was the same in the principal directions having the value of $-0{\cdot}158$. This agreed with the well-known property of thallium crystals that at that temperature the hexagonal α-variety passed into the cubical β-variety.

We have now studied the influence of adding small impurities to thallium crystals. Crystals of thallium were prepared by the method of slow cooling. The magnetic susceptibilities were determined by the Guoy method, the magnetic force being found with a sensitive balance. Full details of the method are given elsewhere.[2] Different samples of the metal gave values which agreed very well with the values of Rao and Subramaniam.

On adding small quantities of lead (within 2 per cent.), $\chi_\perp$ was found to increase slightly while χ_{II} decreased considerably. The magnetic anisotropy fell from 2·56 for the pure metal to 2·00 when there was 2 per cent. of lead. Bismuth produced the same change as lead but the changes were much more pronounced.

We have also studied the influence of adding small quantities of tin. $\chi_\perp$ increased considerably while χ_{II} decreased rapidly when the percentage of tin in the crystal was increased. When nearly 1·5 per cent. of tin was present in the crystal the magnetic anisotropy was found to be 1.

The influence of cold working on the single crystals was also investigated. The general effect was found to be an increase of $\chi_\perp$, a decrease of χ_{II} and consequently a decrease in the value of the magnetic anisotropy.

Full details of this investigation including a discussion of the results will be published elsewhere.

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A. S. Narayanaswamy.
Annamalai University,
Annamalainagar,
December 6, 1937.

[1] Rao and Subramaniam, *Phil. Mag.*, 1936, **21**, 609.
[2] Susceptibility values are given in 10^{-6} units.
[3] Rao, *Proc. Ind. Acad. Sci.*, 1936, **4**, 186.

Rottlerin—Part II.

The substance $C_{19}H_{21}O_5N$ (†) m.p. 206°, described by us[1] has been further investigated. Rottlerin tetramethyl ether (19·5 g.) was treated with sodium nitrite in glacial acetic acid and 17·5 g. of the above substance was isolated. Therefore it is clear that the substance cannot have 19 carbon atoms. The other possibility, namely, that oxides of nitrogen have added to one of the double bonds seems more plausible in view of the high yield. This point is being further investigated.

The above substance, m.p. 206°, on catalytic reduction with palladium and hydrogen is converted into a substance m.p. 162° after crystallisation from alcohol. [Found: C, 63·44; H, 6·23; N, 4·0.] These analytical values have yet to be established by duplicates. This substance (m.p. 162°) when treated with alcoholic alkali and warmed, passes into solution and unlike the unreduced substance, m.p. 206°, does not give any benzaldehyde. This latter observation proves that the addendum has not added to the double bond carrying the phenyl group (Ph. CH = CH —). The alkaline solution of the substance (m.p. 162°) furnishes another substance, m.p. 139° (pale yellow needles from alcohol) on acidification. This substance gives C, 63·33; H, 6·12; N, 4·13% and seems to be isomeric with the substance, m.p. 162°.

We have considered the possibility of $C_2H_3N_2O$ adding to one of the double bonds of tetramethyl rottlerin, the calculated values of C, H and N of the substances m.p. 206°, m.p. 162° agree well with those found but difficulty arises with the substance m.p. 139° which can be accommodated only if it is assumed that the acetoxy group has not been split off by alkali—rather a difficult assumption to make. We are further investigating the nature of these substances.

We may mention that the substances (m.p. 162° and m.p. 139°) are resistant to reduction by platinum oxide catalyst. The substance m.p. 162° on oxidation with aqueous acetone potassium permanganate solution gives a substance m.p. 123°. (Found N, 2·89 per cent).

Further work is in progress.

K. S. Narang.
J. N. Ray.
B. S. Roy.
University Chemical Laboratories,
Lahore,
December 4, 1937.

[1] Narang, Ray and Roy, *Curr. Sci.*, 1937, **6**, 156.

*Cyclo*pentyl and *Cyclo*hexyl Succinic Acids and Resolution of *Cyclo*pentyl Succinic Acid.

The cardiac aglucones would seem to owe their physiological action to the lactone group in the molecule, and the ætiocholane ring structure perhaps serve the purpose of a convenient framework for the resting of the lactone group. To throw light on this assumption as also to verify the mechanism of formation of the lactone group from the side chain of norcholanic acid as postulated by Windaus,[1] work has been started. The object is to synthesise lactones of relevant structure but carrying different rings.

A standard method had to be devised for the synthesis of α-ring-substituted succinic acids which are to constitute the starting material for the synthesis of the lactones. The condensation of *cyclo*pentanone with ethyl α-bromosuccinate was studied with a

view to obtaining ultimately *a-cyclo*pentyl succinic acid. Due to poor yields the method was not found feasible. We find *cyclo*pentyl and *cyclo*hexyl-bromides condense with ethyl sodio-*a*-carbethoxy-succinate[2] to give *a-cyclo*pentyl and *a-cyclo*hexyl *a*-carbethoxy succinate, b. p. 166°/mm., and 168°/45 mm. respectively, in good yields. Hydrolysis followed by decarboxylation of the tri-esters yields *cyclo*pentyl succinic acid, m.p. 117° (anhydride, b.p. 176°/30 mm; and Et ester, b. p. 142°/6 mm.) and *cyclo*hexyl succinic acid, m.p. 143°. The Wislicenus reaction[3] on the two succinic acids are being studied to obtain the *a*-formyl succinic acids.

*a-Cyclo*pentyl-succinic acid has been resolved with the help of brucine (neutral salt). The *d* and *l* acid had $[\alpha]_D^{26} + 17{\cdot}81°$ ($l = 1$, $c = 2{\cdot}358$ in acetone) and $[\alpha]_D^{26} - 16{\cdot}94°$ ($l = 1$, $c = 1{\cdot}830$ in acetone) respectively. The active forms melted at 135°.

The author wishes to thank Prof. P. C. Guha for his interest in the work.

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Bangalore,
December 9, 1937.

[1] Windaus, *Nachrichten von des Gesellschaft der Wissenschaften zu, Göttingen*, new series, **1**, No. 7.

[2] Bischoff, *Annalen*, 1882, **214**, 38.

[3] Wislicenus *et alia*, *Annalen*, 1908, **363**, 365, *et ante*.

Influence of Spike Disease on the Mineral Metabolism of Sandal.

Spike disease in sandal has been shown to adversely affect the chemical composition of its leaves[1] and twigs.[2] Thus, the most significant features of the diseased tissues are manifest in a striking diminution of their lime content and a characteristic accumulation of starch in them. Although the nitrogen and potassium make up of such material is also seriously affected, the nitrogen changes of diseased specimens are more pronounced than their potassium contents. It was also shown that the infective tissues are characterised by a lower ratio for Ca/N than that for the corresponding healthy ones.[1] An examination of the roots from healthy and spiked plants yielded some interesting data which are presented here.

Calcium and Nitrogen Contents of Different Parts of Sandal (expressed as per cent. on dry weight.)

Part of plant examined	Calcium		Total Nitrogen	
	Healthy	Spiked	Healthy	Spiked
Leaves	2·85	0·28	2·19	3·64
Stems	0·84	0·31	1·05	1·94
Roots	0·35	0·67	0·85	0·14

This feature of spike has been verified for a large number of plants derived from different localities. The rapid mobilisation of nitrogen from the roots to stems and leaves in spiked plants is worthy of note. On the other hand, the corresponding roots are significantly richer in calcium. Again, in regard to this entity, the gradient is reversed being low in the foliage and high in the roots of the affected plants. Therefore, the availability of this constituent to the growing points is limited. A similar abnormality was recorded in the case of *Vinca rosea*[3] spike.

It is extremely difficult to account for the above modifications. It is well known that the haustorial connections of sandal roots are slowly weakened with the onset of disease, with the result that in advanced stages, very few of them function actively. Moreover, the root ends also are dead. While it may seem plausible for the mobilisation of calcium from the crown to the roots, careful examination of soils on which sandal plants were growing, revealed some interesting facts. Thus, the calcium content of soils below healthy plants was nearly 50% of that with reference to spiked specimens. This is irrespective of localities and seasonal variations. Although the parasitic habit of sandal is an important factor to reckon with, the facts that the foliage of predisposed plants contains an abnormally high amount of calcium and evinces a low value for nitrogen,[4] combined with our own observations that applications of lime as manure have not tended to decrease the incidence of spike in the field, point to a necessity for a critical examination of the rôle of calcium and nitrogen in health and disease.

Such a study is in progress and will be reported elsewhere.

A. V. VARADARAJA IYENGAR.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 29, 1937.

[1] *J. Ind. Inst. Sci.*, 1928, **11A**, 97; 1929, **12A**, 295.
[2] *Ibid.*, 1928, **11A**, 241.
[3] *Ibid.*, 1935, **18A**, 61.
[4] Unpublished work.

Pillow Structures in the Mica Traps of the Chitaldrug Schist Belt.

INDICATIONS of pillow structures in some of the intermediate and basic lavas of the Chitaldrug schist belt had been noticed in 1925 by Mr. B. Rama Rao, the present Director of the Mysore Geological Department. In the early part of May of this year, when I started surveying the southern portion of the Chitaldrug schist belt in the neighbourhood of Madadkere, Hosadurga Taluk, he drew my attention to this fact and asked me to study the structures carefully in the exposures to the south of Kereaganahalli.

My close examination of the above exposures confirms that the ellipsoidal weathering (Figs. 1 and 2) of the yellowish-green mica traps of the area is undoubtedly due to the original pillow structures. The "pillows" could be well studied in the rocks exposed in the bed of watercourse due south of the Kereaganahalli tank, and they could be traced persistently for a distance of more than half a mile along this. The ellipsoidal structure is prominently developed along four bands; in the eastern two bands the ellipsoids are larger and more conspicuous than those in the western two. Some of the individual ellipsoids or "pillow sacks" in the former group are as much as 3–3½ ft. in length but many are only 2–2½ ft. long. They are usually 1½–2 ft. in width. The ellipsoids in the western bands are about 9–18 inches in length and half as much in width. In cross-section the height of the ellipsoids is about 2/3 of their length.

Fig. 1.

Ellipsoidal weathering in mica trap—S. of Kereaganahalli Tank.
(For the sake of clearness, outlines of pillows have been indicated in dotted lines.)

Fig. 2.

Cross-section of an 'Ellipsoid' in the mica trap—S. of Kereaganahalli Tank.

Similar structures have also been noticed further north of this area at the following places:—

(1) In the watercourse flowing S.E. of Mahadevankatte village (Fig. 3).

(2) In the Railway cutting about 6 furlongs west of Amritapur station.

The absence of all signs of severe crushing in the ellipsoidal masses shows that the structure is not due to any lateral compression of spheroidal jointing. Moreover,

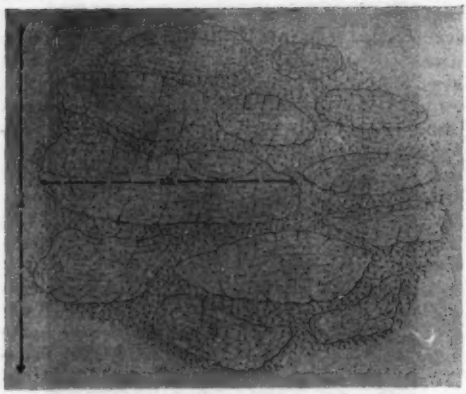


Fig. 3.

Sketch showing the "elliposoidal structure" in the lavas, S. E. of Mahadevankatte.
(Extracted with permission, from Mr. Rama Rao's field notes.)

their close association with the current-bedded and ripple marked quartzites, conglomerates, grits and argillites of sedimentary aspect clearly indicates their sub-aqueous origin.

In the mica traps of the Kereaganahalli exposure there are a few thin bands of a fine grained dark bluish compact "Hornstone" which are traceable for more than hundred yards in length. They seem to me to be the indurated and intercalated ash beds. Petrographic descriptions of these pillow structured mica traps and their associated ash beds, etc., will be given in due course in the publications of the Department.

I am not aware of any recorded instance of the occurrence of *true* pillow lavas in the Dharwar schists. It would be interesting to ascertain whether they could be detected in the Dharwar schists elsewhere, outside Mysore.

I am thankful to the Director, Mysore Geological Department, for having kindly permitted me to publish this interim account of my observations, in this journal.

B. N. RAGHUNATHA RAO.

Mysore Geological Department,
Bangalore,
November 11, 1937.

Inheritance of the Flowering Character in Rice.

SEVERAL crosses were tried between some of the summer (early), autumn (medium) and winter (late) rices. In a cross between a summer and an autumn rice there was a difference of about 41 days in flowering between the two parents. The F_1 plants were more or less intermediate inclined much towards the early parent. The actual segregation of the F_2 progenies showed about a normal curve which probably represented a multiple factor inheritance. The transgressive segregation was rather one-sided, *i.e.*, the early plants were as early as the early parent, while some of the late plants were much later than the late parent. Two more crosses between the summer and autumn rices showed practically the same result.

In a cross between an autumn and a winter rice the F_1 was definitely intermediate and the F_2 had a wide range of variation with transgressive segregation on both sides. Graphically, the F_2 population segregated with a bi-model curve showing clearly a ratio of 3 late : 1 early.

In two other crosses between the summer and winter rices the F_1 was intermediate and in F_2 the transgression was again one-sided, *i.e.*, towards the lateness only.

From the above it transpires that we do not get plants earlier than the earliest (summer rice) pure line types we have in our collection.

P. M. GANGULI.

Karimganj (Assam),
October 31, 1937.

A Note on the Development of the Female Gametophytes of Some Malpighiaceae and Polyembryony in *Hiptage madablota*.

THE development of the female gametophytes of the three genera, *Hiptage*, *Stigmatophyllum* and *Banisteria* takes place on the same lines as those of *Malpighia* and *Bunchosia* (Schurhoff, 1924).

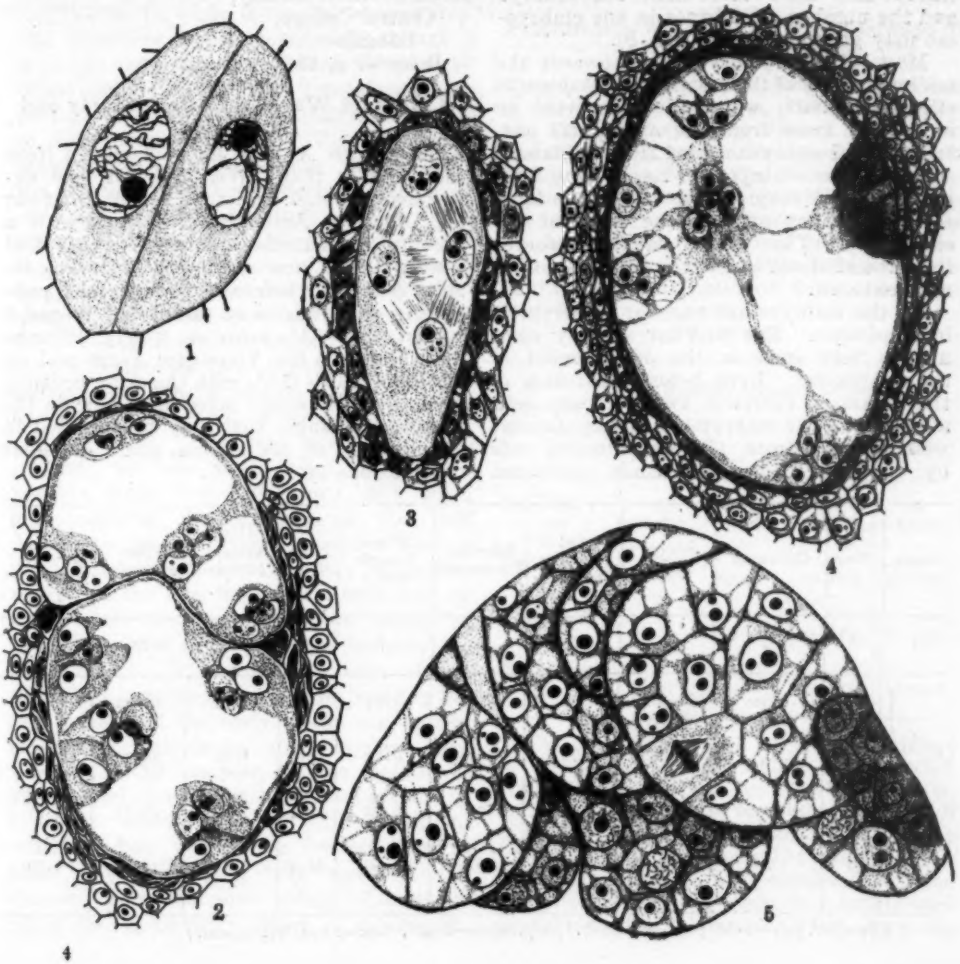
Female Gametophytes.—The megasporangium takes its origin on a lateral outgrowth of the carpellary wall. The archesporial cells are hypodermal in origin and cut off a large number of parietal cells to form a massive parietal tissue. Multiple archesporium is fairly common in all the three genera. No mention of the presence of multiple archesporium has been made in

Malpighia coccinea and *Bunchosia nitida* (Schurhoff, 1924). It is also present in another species of Malpighia, *M. punicifolia* (Narasimhachar, 1936, to be published). Of the several archesporial cells, usually one develops to function as megaspore mother-cell. Occasionally, the presence of two mother-cells is noticed (Fig. 1). The development of these two megaspore mother-cells may proceed up to the formation of two sixteen-nucleate embryo-sacs (Fig. 2). The mother-cells are easily distinguished from the surrounding cells by big-sized nuclei, and their cytoplasm is fibrillar round the nucleus and highly vacuolated at the periphery.

The development of the megaspores is of the "Lilium type".

The two daughter nuclei formed after the heterotypic division give rise to four nuclei. During the homoeotypic division the spindle fibres are commonly placed in an oblique position. Secondary spindle fibres arise and connect the four nuclei to one another (Fig. 3).

The young embryo-sac becomes highly vacuolate and the nuclei divide in their respective places and give rise to a sixteen-nucleate embryo-sac (Fig. 4). The embryo-sac enlarges very much at the cost of the surrounding tissue. The fully developed



embryo-sac has four egg-apparatus and four polar nuclei at the centre. The three nuclei of the egg-apparatus are not well organised into synergids and egg. Invariably all the four groups of the egg-apparatus degenerate. The course of development described is common to all the three species, *Hiptage madablota*, *Banisteria laurifolia*, *Stigmatophyllum aristatum*. The last two plants do not produce seeds in Bangalore.

Polyembryony.—The occurrence of polyembryony has been reported, as early as 1860 by Braun, for *Stigmatophyllum* and *Banisteria*. Polyembryony in *Hiptage madablota* is very common. Almost all the embryo-sacs show more than one embryo and the number of embryos in one embryo-sac may go up to eight (Fig. 5).

Most of the embryos are towards the micropylar end of the sac unlike in *Aspicarpa* (Ritzerow, 1907) where it is reported to have been away from the micropylar end. Instances of embryos arising from the lateral sides of the embryo-sac have also been observed and they also develop into large embryos. They are not the rule but are exceptions. The origin of the embryos from the chalazal end of the embryo-sac has not been seen.

All the embryos are nucellar in origin as in *Aspicarpa*. The nucellar activity commences very early in the development of the embryo-sac. Even before the fusion of the polars is complete two or more cells adjacent to the embryo-sac cavity become well marked from the sourrounding cells by having rich cytoplasmic contents. The nucellar cells which develop into embryos divide several times and give rise to a tissue, which later on forms the stem tip, and a short massive suspensor-like portion. Mature seeds sometimes show two or three embryos, though only one of them develops further at the time of germination.

The details will appear elsewhere as a separate paper.

Acknowledgements are made to Dr. M. A. Sampathkumaran and Mr. L. Narayana Rao for kind guidance.

A. M. Subba Rao.

Department of Botany,
Central College,
Bangalore,
December 8, 1937.

A Note on Wagad 8 Cotton—Early and Late Sown.

Koshal and Ahmad[1] have concluded from their results that "Well-designed field experiments should be carried out at Dharwar and Nandyal Agricultural Stations with a view to find out the optimum conditions of sowing". In view of this, the following results (obtained before the above was published), of fibre tests on samples of Wagad 8 cotton (1933–34), sown on widely different dates, both on the Viramgam Farm and on the Cultivator's field, with the same pedigree seed, are of interest: since they indicate the nature of changes that may be expected in the quality of the cotton under different "conditions of sowing".

Group	No.	Grown on	Sowing Date	Period of Ripening (months)	Ginning Percentage	Fibre Length (ins.)	Fibre I.P.	Fibre Weight 10^{-7} ozs. per in.	Fibre Maturity	S.H. 10^{-7} ozs. per in.
1	2	3	4	5	6	7	8	9	10	11
I	1	Farm	29–6–33 (early)	8½	35·3	0·84	14·3	1·83	63–15	1·91
	2	,,	5–10–33 (late)	7½	34·8	0·78	12·2	1·24	33–25	1·46
II	3	Cultivator's field	25–7–33 (early)	5½	40·7	0·83	12·1	1·88	70–16	1·91
	4	,,	28–9–33 (late)	5	38·5	0·80	14·4	1·51	48–27	1·70

(*Rainfall*: July—9·50″; August—26·27″; September—5·64″, October end, one shower.)

The results show that the crop maturation period (Col. 5), has been shortened for the later sown crop in both the groups. The differences in ginning percentage (Col. 6) cannot be considered significant, as they do not exceed, in either group, 2 per cent. and as this type is known to fluctuate widely in this property : however, since the tendency of the late sown sample is in the same negative direction in both the cases (either Farm or Cultivator's), it may be deduced safely that late sowing tends to decrease the ginning percentage. The early sown Farm sample has a significantly higher fibre length (Col. 7); while, in the Cultivator's crop, the difference is not significant, though it is in the same direction. There is no significant difference in Fibre Irregularity percentage (Col. 8). A wide difference occurs in fibre weight (Col. 9). The early sown samples have a significantly higher fibre weight than the corresponding late sown ones and are thus definitely coarser. The maturity differences (Col. 10) point out that the relative fineness of the late sown samples is due to want of structural development of the fibres—low secondary thickening. A close inspection of the figures shows that although the later sowings in both the groups were done in almost the same week, they manifest large differences in their ripening time. The late sown Farm crop matured as late as in April, May — hot months, while the Cultivator's late sown crop matured in February, in the cold weather. It is therefore possible that a good part of the low maturity and fibre weight of the late sown Farm crop may be due to the shorter maturation period of bolls associated with the high temperature of summer. A comparative idea of the difference in intrinsic fineness as between the late sowns and the early sowns can be obtained by calculating the Standard hair weight for the samples, by the method of Pierce and Lord.[2] The values given in Col. 11 show that the differences in Standard hair weight are smaller than in fibre weight, showing that much of the fineness in the late sown samples disappears when the immaturity effect is eliminated. Some residual degree of fineness, however, appears to be left over, which may be real, but is more probably due to the inadequacy of the formula to completely eliminate the immaturity effect in this case.

SRINAGABHUSHANA.

Cotton Research Laboratory,
Surat,
July 14, 1937.

[1] Koshal, R. S., and Ahmad, N., "Effects of Rainfall on the Quality of Indian Cottons," page 30. (Paper read before the First Conference of Scientific Research Workers on Cotton in India, 1937.)

[2] Pierce, F. T., and Lord, E., "Empire Cotton-Growing Corporation," *Report of Second Conference on Cotton-Growing Problems*, 1934, p. 229.

Preliminary Note on the Blood Groups of the Aborigines of Bihar.

THE District of Santal Perganas in Bihar is the homeland of two primitive tribes—the Dravidian speaking Mālérs[1] residing on the hills and the Mundari speaking Santals living in the plains. The Mālérs are still in a primitive state of culture while the Santals are progressive and constitute numerically the largest single aboriginal group in India. The blood groups of the Hills Mālérs and the Santals were all obtained from the above District.

TABLE I.

Tribe and No. of Subjects	Numbers belonging to Groups			
	O	A	B	AB
Hill Mālé 139	65 46·76%	22 15·83%	44 31·65%	8 5·76%
Santal 199	64 32·16%	41 20·60%	70 35·18%	24 12·06%
Orāon 35	9 25·71%	9 25·71%	11 31·43%	6 17·14%
Bagdi (Bengal) 44	7 15·91%	11 25·00%	19 43·18%	7 15·91%

The Mālérs have the highest percentage of the blood group O unlike that of other Dravidian tribes,[2] who are usually high in A, and the characteristic high proportion of B of North India is also noticed to some extent in the Mālérs and the other groups. The Orāon blood groups were obtained from the suburbs of Calcutta, where they immigrated as field or day labourers. They show the

highest percentage of the group A among the three groups of Bihar compared and equal to that of the Bagdis of Bengal. The Bagdi blood groups were obtained from South Bengal in the district of 24 Perganas where they live upon agriculture and fishing. The Bagdis have the highest percentage of B and the lowest of O. The Santals also possess a high percentage of B and an almost equal amount of O. The Bihar Aborigines are characterised by a high frequency of the genes R (group O) and B while the Bagdis possess chiefly the genes A and B. The gene A may have come as an intrusive element from the south, but the final solution of all and kindred questions will have to wait till adequate materials have been obtained from all the contiguous territories.

In carrying out this work, I received a great deal of help from Dr. E. W. E. Macfarlane, D.Sc. (Lond.), for which thanks are due to her.

S. S. SARKAR.

Bose Institute,
Calcutta,
December 2, 1937.

[1] Sarkar, S. S., *Curr. Sci.*, 1933, **1**, 318.
[2] (*a*) Macfarlane, E. W. E., *Curr. Sci.*, 1936, **4**, 653.
(*b*) Aiyappan, A., *Man*, 1936, 255.

LAST week Mr. S. S. Sarkar and I visited the villages where he had previously obtained Bagdi bloods. The distribution of the blood groups in the earlier sample of 44 Bagdis showed an unusually high percentage of Group B. We are able to classify the bloods of 20 more in these villages and I have also tested 16 Bagdi bloods at Budge Budge. We now have data from 80 Bagdis of the 24 Perganas District, Bengal, and find that the percentages of the four blood groups and the frequencies of the blood group genes both show a strong resemblance to those found among the Santals by Mr. Sarkar. Mr. Sarkar has asked me to supplement his recent communication to you for the data no doubt give a more correct idea of the following blood group situation in the Bagdis :—

No. of Bagdis 80 ; Group O 25 (31·25%), A 18 (22·5%), B 28 (35·0%), AB 9 (11·25%). Frequencies of the genes : $p = 17·98$, $q = 26·07$, $r = 55·95$.

EILEEN W. E. MACFARLANE.
C/o Burmah Shell, Budge Budge,
Bengal,
December 4, 1937.

Distribution of the Genus *Sagitta* during the Several Months of the Year in the Indian Seas.

IN the March issue of the *Records of the Indian Museum*, I saw a paper by Dr. C. C. John on "Seasonal Variations in the Distribution of *Sagitta* of the Madras Coast" based on collections made by the University Zoological Laboratory, Madras, but worked out independently at Agra. The main conclusion of John is : "The distribution of *Sagitta* is at its minimum when the rainfall is very heavy, but it cannot be applied as a general rule that the distribution of *Sagitta* is inversely proportional to the rainfall, because slight occasional showers or irregular rains do not affect their intensity. From these observations the conclusion is drawn that *Sagitta* disappears from the surface plankton when the salinity of the sea-water is appreciably altered by the admixture of rain and tributary waters" (p. 92). As I have not been able to correlate the results of John (1937) with those recorded by Menon (1931) and Aiyar, Menon and Menon (1936), I shall trace the history of the question of the occurrence of *Sagitta* on the Madras Coast and point out the difficulties in the acceptance of the claims of John.

All these results are based on collections made by the Department of Zoology of the University of Madras. In the year 1931 Mr. K. S. Menon published "A Preliminary Account of the Madras Plankton". In page 491 of Menon's paper occurs the statement : "While a few forms such as *Sagitta* and *Pleurobrachia* do not show much variation in numbers throughout the year, and do not have a definite maximal period, most of the organisms exhibit a regular seasonal abundance, and corresponding periods of maxima and minima". Further, under the heading "Chætognatha" the following observation is met with : "*Sagitta bipunctata* (Q and G). Present practically all through the year. Scarce in May and July" (p. 505). Regarding the method of enumeration of numbers, Menon rightly remarks : "The bigger forms, such as *Sagitta*, were picked out and counted. The rest of the sample was spread out and examined on a ruled slide, and the numbers of the separate organisms counted. It must be borne in mind that the counts arrived at by such a process would in no

case represent the number of organisms in any known volume of sea-water. For one thing it is impossible to calculate even approximately the speed of such a crude craft as the catamaran and, likewise we had no knowledge of the currents on the coast. So the amount of water draining through the nets for any given length of time remained an unknown quantity. The graphs given, based on these results, while having no value as showing the numbers of any particular form in unit volume of sea-water, serve, however, to give a very good idea of the intensity of the various maxima" (p. 490). Further, Menon says: "In the neighbourhood of Madras town, however, there are no rivers worth mention, and the two small ones that are present are little more than drainage channels and are dry practically throughout the year, having connection with the sea during the monsoon period only (Mid-October to December). This fact must have considerable importance as far as life in the coastal waters is concerned, since not much of organic and inorganic food material is brought down into the sea, nor is there such a drainage of fresh-water into it as to make any very great variation in the salinity, which varies from 32 in September–November to 34·5–35 in June–August (Sewell, 1929 *b*)" (p. 489).

John examined the collections of Menon (1933) and points out: "The *Sagitta* of the East Coast of India has never been identified before. The only reference to it is found in the *Reports* of the Siboga Expedition (Fowler, 1906). Though that expedition did not investigate the Bay of Bengal, in two of the charts on the distribution of the genus, Fowler shows the occurrence of *S. enflata* and *S. subtilis*. Later when one of the officers of the Madras Fisheries Department proceeded to England, he took with him a few badly preserved specimens, which were doubtfully identified there as *S. bipunctata* and the account of the previous worker was probably based on that" (p. 1). He identifies five species, *S. enflata*, *S. gardineri*, *S. neglecta*, *S. tenuis*, and *Srobusta*, in the collection.

This clarification of the species question has been accepted by Aiyar, Menon and Menon (1936) who record *Sagitta* Sp. occurring throughout the year, including the months of September and October. Leaving alone the maxima of the different species, the fact will have to be admitted that the genus *Sagitta* occurs throughout the year (see Lele and Gae, 1936). This fact is accepted by John partially as the following sentence of his will show: "Menon observed that *S. bipunctata* occurs in the plankton collections fairly regularly and uniformly during all seasons. In a review of this paper published in *Nature* (1932) the conclusion was drawn that this uniform distribution is probably due to the tropical condition of the sea" (p. 83). But John's explanation (1937) that it was the mistake in the identification of *Sagitta* by Menon "which was responsible for the misconception that *Sagitta* occurs fairly constantly during all the seasons:···" (p. 83) does not stand to reason. It does not matter whether one species or other has a maximum in a particular month, but the fact that the genus *Sagitta* occurs throughout the year is patent from Menon's paper. In view of the above considerations I find it difficult to accept his conclusion: "It may therefore be concluded that from the middle of September till the beginning of November *Sagitta* are not found in the surface plankton fauna of the Madras coast" (p. 86).

Analysing his results further, there are also the following contradictions: In his paper on "*Sagitta* of the Madras Coast" (1933) I find the following remark about the occurrence of the various species: "In the present paper five species *S. enflata*, *S. gardineri*, *S. neglecta*, *S. tenuis* and *S. robusta* have been identified of which *S. enflata*, *S. gardineri* and *S. tenuis* occur abundantly. *S. neglecta* is *very scarce*[1] and I have been able to obtain *only a very few specimens from the entire collections*" (p. 1). From the statement: "Considering the number of species obtained from the Maldive and Laccadive Islands by Doncaster (1902) it is possible that some more species may be obtained from the Bay of Bengal with better methods of collection," it is clear that only five species were obtained by John after a thorough examination of Menon's collections (John, 1933). In his recent paper he states that two more species have been identified. It has to be pointed out here that the paper is only the result of a re-examination of the old material and no better methods of collection have been employed. Yet as John has described two more species and gives as many as 1,953 specimens of *S. planktonis*

and 1,845 specimens of *S. hispida* and describes them also as occurring during the months of June, July and September in 1929, April, May, June, July and August of 1930, a statement how these two species which are represented by so many individuals were missed by him in his previous examination and with what other species they were confused, would have helped to clear the issues. The total number of each species examined by John is given below.

Species	1929	1930	1931–32	Total
S. tenuis ..	39	3689	4791	8519
S. enflata ..	597	2049	2363	5009
S. gardineri ..	652	1815	1922	4499
S. neglecta ..	35	673	2110	2818
S. planktonis ..	455	403	1095	1953
S. hispida ..	318	527	1000	1845
S. robusta ..	..	175	276	451
Doubtful Forms ..	4	18	23	45

One is surprised to note that the terms "*scarce....very few in the entire collection*[1]" of *S. neglecta* is used to mean 2,818 specimens! Tabulating the different totals one finds that *S. neglecta* comes a good fourth leaving *S. robusta* well behind even the "two more species" in point of numbers.

While agreeing with Menon (1931) that the results only give an idea of the various maxima, I have to point out here that the *Sagitta* has been picked out of the collections by John himself in 1932 and 1933. It is quite probable that some of the specimens may have gone into the wrong tubes, and some lost, and it is surprising that the above factor is not taken into consideration in arriving at results which seem to contradict what has been previously said about this aspect by Menon (1931), Aiyar, Menon and Menon (1936). About the latter there is also no reference in John's paper and the curious fact is that while *Sagitta* is recorded by Aiyar, Menon and Menon in September and October, John's examination of the same material shows no *Sagitta* (!!) to which phenomenon great significance is attached by him.

The effect of rain on the salinity of the Bay of Bengal is dealt with fully by Sewell (1929) and in a paper in which the conclusions are drawn entirely from the supposed effect of rain on sea-water, no reference is made to Sewell's paper. Nor is there any information given as to the source from which the amount of rainfall for each month is taken.

An analysis of the sea-water made by me during the years 1932–33, shows that Sewell's conclusions are fairly applicable even to coastal waters and as the variations in salinity from December to August is about 6·43 gm. per litre of sea-water (see p. 179, Subramaniam and Gopal Aiyar, 1936), the fact will be admitted that *Sagitta* can withstand great changes of salinity as John's Tables themselves show *Sagitta* occurring from December to August, for which salinity records of the Bay of Bengal have already been published. It is no doubt well known that the macroplankton is affected by salinity changes but the point at issue is whether similar conclusions could be drawn from the meagre data presented by John.

Coming now to the actual interpretations of the results, one is surprised to find grave misinterpretations of the observations of other workers. Regarding the monsoon John says: "The south-west monsoon commences on the west coast of India somewhere about the middle of May and its vigour continues on till the end of June. During October Bombay again gets a fair share of rain from northerly winds" (p. 90). Still Lele and Gae (1936) state as follows regarding *S. gardineri*, *S. bedoti* and *S. bombayensis*. "These arrow-worms are usually found throughout the year and although colourless and transparent they attract one's notice by their darting movements" (p. 2). *S. gardineri*. "This species was abundantly found in winter. Although it was not found in the months of March, April and May of 1933 later collections have shown that it is not altogether absent during these months" (p. 4). *S. bedoti*. "This is the most common *Sagitta* of Bombay and is found in fair numbers throughout the year" (p. 6). *S. bombayensis*. "This species is present in the Bombay Harbour throughout the year but it appears *in swarms during the South-West Monsoon*[1]" (p. 9). The table of Seasonal variation in the population observed by them is given below.

Month	*S. gardineri*	*S. bedoti*	*S. bombayensis*
January ..	130	590	587
February ..	20	260	79
March ..	..	7	8
April ..	..	803	688
May ..	..	375	183
June ..	16	105	1,336
July ..	97	428	1,243
August ..	187	753	184
September ..	267	604	378
October ..	60	32	30
November ..	728	110	62
December ..	1,028	203	165

John explains that his conclusion regarding seasonal variation is supported by Lele and Gae's results in the following manner: "Of the three species described by him *S. gardineri* is the only one, in which the body wall is thin, flabby and from the table of surface distribution which he has given it will be seen that during March, April and May *S. gardineri* is totally absent, from the Bombay Coast. In June, it is very scarce but from that time onwards there is a steady increase till September" (p. 89). If rain affects the salinity of the sea-water so much as to make the *Sagitta* disappear from the surface plankton, it is surprising that *S. gardineri* of Bombay which is absent during the hottest months of the year, when the salinity should be very high, should appear even though in small numbers during the actual monsoon season! John's explanation that *S. bedoti* and *S. bombayensis* have rigid body walls and that probably this characteristic "enables these two species to withstand certain degree of chemical changes in the sea" does not explain why *S. bombayensis* should appear in "*Swarms*"[1] during the South-West Monsoon. John conveniently omits *S. bombayensis* from any consideration due to the fact that being a new species more details regarding its habit and distribution are necessary. I wonder what the species question has to do with the effect of the environment on an animal.

Doncaster (1902) records that Stanley

Species	Doncaster	John
1. *S. enflata*	Very abundant in both winter and April making up perhaps 50 per cent. of the collection	....
2. *S. magna*	Abundant in winter, but not found in April	....
3. *S. tricuspidata* ..	Scarce in winter and not found in April	Not found in April
4. *S. serratodentata* ..	A moderately common species in winter and spring	Common in winter and spring
5. *S. hispida*	Scarce in winter, abundant in April	Scarce in winter, abundant in April
6. *S. regularis* ..	Small numbers in winter	Small numbers in winter
7. *S. flaccida*	One specimen in April	....
8. *S. robusta*	Abundant in winter, but scarce in April	Abundant in winter, but scarce in April
9. *S. ferox*	Abundant in winter, absent in April	....
10. *S. gardineri* ..	Moderately abundant in winter	Moderately abundant in winter
11. *S. pulchra*	Moderate numbers in both winter and spring	Moderate in winter and spring
12. *S. polyodon* ..	Found in fair abundance in winter and spring	Fairly abundant in winter and spring
13. *S. septata*	Moderately common in winter and spring	Moderately common in winter and spring

Gardiner's Expedition collected 900 *specimens between December 10th*, 1899, and 10th *January* 1900[2] *and 'over* 250' *in April* 1900. For comparison Doncaster's results are given side by side with John's interpretation of Doncaster's results.

The Laccadive Archipelago forms with the Maldives a long narrow belt and a description of the monsoon and rains in Laccadives will equally apply to Maldives also. Ellis (1924) mentions in the case of Laccadives: "The South-West Monsoon usually becomes definitely set towards the end of May and continues regularly until September" (p. 2). "The greater part of the rain falls during the South-West Monsoon in the months of June and July. During the rest of the year, *except in November and December when the North-East Monsoon brings heavy showers*,[1] there is but little rain" (p. 3). Thus the collections examined by Doncaster are of material townetted *just during*[2] the North-East Monsoon (December to January and *just before* South-West Monsoon (April). The terms "winter" and "spring" used by Doncaster have no other significance than a reference to the climate in England at the time the material was collected in the Maldives and Laccadives. Having shown previously that John's interpretation of Lele and Gae's (1936) result is erroneous, I shall show that a similar mistake is committed by John in the interpretation of that of Doncaster also. John infers that "in the Maldive and Laccadive regions almost all the species reach their maxima during the colder months November to January....." (p. 91). This result does not at all support John's conclusions, for in the quotation cited previously, Ellis definitely mentioned that the North-East Monsoon brings heavy showers during November and December and the collections examined by Doncaster were made from December 10th to January 10th. Thus while Doncaster's results are not strictly comparable to those of John because no collections were made by Gardiner's Expedition in the rainy season (South-West Monsoon) they distinctly contradict John's results, for, during the period of the North-West Monsoon when salinity, according to John's suggestion, should be low, more *Sagitta* was collected by the Expedition (900) than during the summer months before the South-West Monsoon (above 250), when salinity would be the highest for the year.

To one analysing the results of Doncaster (1902), Menon (1931), Aiyar, Menon and Menon (1936) and Lele and Gae (1936), it appears that the genus *Sagitta* occurs throughout the year in the Arabian Sea and the Bay of Bengal, different species having their maxima in different months of the year. As John himself states that *S. enflata* has not a rigid body wall like *S. bedoti* and *S. bombayensis* (p. 90) and as this species is recorded by Doncaster *as occurring abundantly in both December, January and April and forming fifty per cent. of the collections*,[1] John's explanation in the case of *S. bedoti* and *S. bombayensis* that their occurrence throughout the year may be due to the rigid body wall cannot bear a moment's scrutiny.

Only general conclusions could be drawn from collections made with crude crafts such as the catamaran and the fact remains that the genus *Sagitta* occurs throughout the year as evidenced from the results of Doncaster (1902), Lele and Gae (1936) on the Arabian Sea coast and Menon (1931) and Aiyar, Menon and Menon (1936) on the Bay of Bengal coast and that they do not disappear from the surface plankton when the salinity of the sea-water is appreciably altered by the admixture of rain and tributary waters.

I wish to express here my deep sense of gratitude to Professor R. Gopala Aiyar for his advice and criticism.

M. K. SUBRAMANIAM.

Department of Zoology,
University of Madras,
December 1, 1937.

[1,2] Italics are mine.

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Technique of the Mural Paintings in the Brihadeswara Temple at Tanjore.

MR. SANA ULLAH'S[1] objections to the fresco theory of the paintings put forward by me in a publication that appeared in *Technical Studies*[2] (Harvard University) can be grouped under two heads, *viz.*, textual and experimental. In a contribution based on experimental proofs, one is not concerned with textual evidences. When more experimental data on Indian paintings become available, than has hitherto been possible, such textual evidences can be more appropriately and critically examined.

Mr. Sana Ullah rightly says that "the nature of the binding medium forms the crux of the problem". To elucidate this point, I have carried out three different experiments: (1) action of water, (2) action of dilute HCl and (3) action of organic solvents: ether, chloroform and carbon disulphide. I have also minutely examined the surfaces of the paintings for brush marks.

It is pertinent to point out here, that the specimens examined by Mr. Sana Ullah were supplied by me from my collection of fragments of painted stucco. It is therefore surprising to read in the note that hot water extracts from the Chola specimens "appreciable" quantities of matter consisting of gypsum and "syrupy organic matter" free from nitrogen and giving negative tests for carbohydrates. My experiments, on the contrary, have shown that the fragments of painted plaster stand prolonged boiling with water and there is no injury, whatever, to the surface of the paint. The paintings stand brushing with wet sponge or rubbing with fingers. Mr. Sana Ullah also mentions elsewhere that "some of the Chola specimens have stood the action of water very well indeed, while others did not remain unaffected long." Thus, different portions appear to exhibit different behaviours. After stating that the process employed was tempera, Mr. Sana Ullah proceeds to explain that the resistance to water is due to the elaborate polishing treatment to which the paintings were subjected after the work was completed. "The particles of colours were thus gradually driven in between the freshly formed crystals of calcite and held there securely." It is difficult to understantd how the process of polishing could have driven the particles into the interstices. Referring to the process of polishing, Laurie[3] concludes that the plaster ground is 'closed in,' painted and then polished. By 'closing in,' a hard, compact surface with the appearance of polished marble is first secured before painting, and polishing is the final process. It is thus difficult to understand the penetration of the pigment into the interstices of a surface so carefully prepared. I shall return to this later.

Regarding the stains, 0·2 to 0·3 mm., beneath the surface observed by Mr. Sana Ullah, my observations are again contradictory to his. I have not detected any stains, faint or indistinct, in the specimens. Without further experimental evidence, the statement that the staining is due to the organic medium is open to question. Further, mere detection of organic matter will not give a decisive clue to the technique employed. Says Laurie[4] in this connection: "the presence of organic matter is not a proof that an organic medium like glue or egg has been used. Such organic matter may be present accidentally in the original material, may form part of one of the pigments, etc."

Treatment with dilute hydrochloric acid provides the necessary evidence for understanding the nature of the binding material. It is needless to add that frescoes and temperas can be distinguished by their strikingly different behaviours towards hydrochloric acid. The specimen from Chola paintings disintegrate readily with effervescence when treated with the acid leaving the pigment in a disintegrated form. If a water-soluble binding medium like glue or gum had been employed, the painted specimens would not have disintegrated on treatment with acid, but would remain as flakes. Mr. Sana Ullah is silent over the results of this very important experiment.

In fresco paintings the binding of the pigment to the plaster is due to calcium carbonate. Laurie[5] observes "when the pigment is flooded over the wet surface of the plaster, the particles settle into the hollows of the surface bathed in a solution of lime. As the solution of lime becomes carbonated and gets precipitated by the carbonic acid of the air, the particles of the pigment are packed round with the precipitated carbonate." These particles appear as particles of pigment in the interstices of the plaster. In this connection, it may be interesting to quote a parallel from the ancient painting of Greece and Rome. Referring to the Minoan Frescoes, Swindler[6] says "the pigments of the Minoan frescoes are interfused and often spread beneath the

wet stucco surface. This is characteristic of the pure fresco method."

My experiments with organic solvents are of value because of their negative results. These experiments show that the medium employed was not soluble in the "fat solvents". The results of all the experiments have to be considered together and they leave no alternative to the fresco nature of the paintings.

I do not consider it necessary for the purposes of this note to discuss the questions relating to the thinness of the plaster or the absence of joins on the surfaces. They have been adequately dealt with in my original paper. It must, however, be mentioned that it is not logical to compare the Chola with Roman paintings. The latter are colossal in proportions; thus the nude figures on the vault of the sistine chapel are considerably above life size[7] and should have taken about two days for painting. There are no figures of this size in Tanjore. The thickness of plaster and the rate of drying should be considered in relation to the time required for painting and the season of the year when the artists executed the work. From the observation that the figures in the Tanjore paintings are of unequal standards, it is probable that many artists working together would have completed the work within the period that the plaster was wet. The walls in the Tanjore temple are divided into horizontal panels by patches of colour and the joins might have been hidden underneath, in which case each panel could have been painted during such time as the panel was wet. Thus several possibilities are admissible.

The results of my experiments with the Nayak paintings were identical with those of the Chola paintings, with this difference that, while particles of pigment were found in the interstices of the Chola plaster, the interstices of the Nayak plaster was free from them. In fact, this is the difference between pure fresco and fresco-secco methods. These considerations clearly point out that the Mural paintings in the Tanjore temple were executed in the fresco technique.

Mr. Sana Ullah refers to my contention that the paintings at Sittannavasal are also in fresco technique. My experimental results here were similar to those got with Nayak stuccoes. In this connection, I cannot but quote the testimony of Dr. Stella Kramrisch of the Calcutta University, who writes to me to say, "I have no objection if you refer to the experiments carried out by you in my presence at Sittannavasal. I have seen that the painted surface resisted the action of water and of organic solvents."

S. PARAMASIVAN.

Chemical Laboratory,
Government Museum, Madras,
December 10, 1937.

[1] *Curr. Sci.*, 1937, **6**, No. 5, 223–25.
[2] *Technical Studies* (Harvard University), 1937, **5**, No. 4, 221–40.
[3] *Greek and Roman Painting*, pp. 85–87.
[4] *Ibid.*, p. 94.
[5] *Ibid.*, p. 83.
[6] *Ancient Painting* (Yale University Press), p. 418.
[7] See "Painting," *Ency. Brit.*, 11th Edition, **20**, 486.

Note on the Distribution of the Mean of Fisher's t^2.

IN the June number of the *Proceedings of the Indian Academy of Sciences*,[1] P. V. Krishna Iyer published a paper on "The Distribution of the Mean of Fisher's t^2 for Samples from a Normal Population". The choice of this title is rather misleading as it suggests that Mr. Iyer has discussed the sampling distribution of the mean of a sample of (say) p independent t^2's whereas his chief result is the algebraic identity of the ratio of the treatments (p in number) and error variances with the mean of all the t^2's [$\frac{1}{2}\ p\ (p-1)$ in number] when each treatment has the same number of observations. He uses the symbol $\bar{t}$ without however explaining what it stands for. It is presumed that it merely replaces the more familiar s_2/s_1 (and is not the mean of all the t's as one would otherwise think).

Mr. Iyer illustrates the 'advantage of his finding' on p. 530 by applying it to a specific problem. But it is quite obvious that the $\bar{t}^2$ he gets in this connection is no other than the ratio of variances appropriate to testing of significance of variations 'between places within persons'. Mr. Iyer's problem comes under the category of $2 \times s$ classification with unequal numbers in each class, the method of analysis of which was given by F. Yates in 1934.[2] There is therefore nothing new in this.

In the last section of the paper on "Suggestions for Improving the Analysis of samples of different sizes", Mr. Iyer considers the case when the group means are derived from samples of different sizes. He rightly states "that the ratio of the variances due to the treatments and residual

error does not, as in the case of samples of equal sizes, reduce to the average of all the t^2's that can be formed" (p. 530). But curiously enough he suggests "that the significance between different groups can be judged better by taking the average of the t^2's".

Mr. Iyer does not appear to have realised that nothing is known about the sampling distribution of what he calls $\bar{t}^2$ in the case of unequal observations. It is therefore absolutely useless for purposes of tests of significance. Even if the distribution is found at some future date, it must be borne in mind that the calculation of Mr. Iyer's $\bar{t}^2$ would involve the squaring of $\frac{1}{2}p\,(p-1)$ quantities. This certainly could not be considered to be an improvement (from the point of view of statistical practice) on the existing *valid* tests of significance based on the 'ratio of variances' given by R. A. Fisher.

Mr. Iyer's suggestion for improving the test of "significance of the difference between means of samples of different sizes" is thus based on a pure misconception.

K. Raghavan Nair.

Statistical Laboratory,
Calcutta,
November 29, 1937.

[1] *Proc. Ind. Acad. Sci.*, 1937, **5**, 528.
[2] *J. Amer. Statistical Assoc.*, 1934, pp. 51–66.

Some Observations on Sir Shah Sulaiman's Theories.

The whole theory of Sir Shah Sulaiman is examined and is found to be, at least in its present form, untenable.

1. After specifying several objections to the Theory of Relativity (a typical example of which is the questionnaire about the spinning top) Sir Shah Sulaiman claims to have found modifications of classical mechanics which not only cover an extensive group of phenomena but are supposed to have falsified Einstein's work.

The basis of Sir Shah Sulaiman's work is the idea that though absolute space and time may not directly manifest themselves yet *because of their existence* (together with the stipulation that all influences travel with finite velocities) certain physico-mathematical relationships can be reached which do justice to a wide range of reality.

The Theory has been cast into the form of "Universal Principles". The first, which is one of the corner-stones of the whole edifice, deals with relative velocity between two bodies and is contained in the formula 23·9, $\frac{v}{v'-u} = \frac{D\,(D+v'-u)}{(D+v')(D-u)}$. A closely allied conception of Sir Shah Sulaiman is that relative velocity between two bodies depends not only on the difference between their absolute velocities but also on the absolute velocities themselves and that the value for relative velocity will vary with the method employed to measure it, *vide* the emphatic remark. ".....the assumption that relative velocity depends only on the difference between absolute velocities causes an error in Newtonian mechanics for which a correction is necessary.....", and Chapter VII.

Before dealing with the formula 23·9 and the related contentions mentioned above it is necessary to bear in mind that the clue to Sir Shah Sulaiman's investigation and my criticism lies in his conception of the velocity D. It is constant, *in space* but *not with respect to observers generally*, *vide* Item 6, Chap. IV, p. 232; third paragraph, p. 124, Chap. VI and the Introduction to Chap. XIII.

This discrimination is indeed the kernel of the difference between the absolutist standpoint of Sir Shah Sulaiman and relativistic conceptions.

I shall examine 23·9 and the other assertions in a perfectly general way. The method adopted is one of *reductio ad absurdum*.

Let us turn our attention to 23·5 and calculate the time taken by the messenger, when A *regards himself at rest*, on the understanding that relative velocity is not merely the difference between absolute velocities but is some function of the absolute velocities and that the relative velocity of the messenger on the outward journey is measured by one method and on the return journey by another, and suppose further that the relative velocity of B has been measured by yet another method. We can then have the three relative velocities as functions $(D-u)\,\phi\,(D, u)$, $(D+u)\,\psi\,(D, u)$ and $(v'-u)\,f\,(v', u)$ of the absolute velocities, the difference in functional *notation* corresponding to the three different, though essentially arbitrary, methods employed to measure the relative velocities concerned.

In the following the details of the calculations, which are straightforward enough, are omitted.

A regarding himself at rest, will accordingly evaluate the time taken to be

$$\frac{r}{(D-u)\phi(D,u)-(v'-u)f(v',u)}+\frac{r+\dfrac{r}{(D-u)\phi(D,u)-(v'-u)f(v',u)}(v'-u)f(v',u)}{(D+u)\psi(D,u)}$$
$$=\left[\frac{r(D+u)\psi(D,u)+r(D-u)\phi(D,u)}{(D+u)\psi(D,u)\{(D-u)\phi(D,u)-(v'-u)f(v',u)\}}\right]$$

and after the manner of 23·6 the distance to be

$$\frac{r(D-u)(D+u)\psi(D,u)\phi(D,u)+r(D-u)(v'-u)\phi(D,u)f(v',u)}{(D+u)\psi(D,u)\{(D-u)\phi(D,u)-(v'-u)f(v',u)\}}.$$

In accordance with the method of item 3, p. 244, Chapter V, the "apparent" (as Sir Shah Sulaiman terms) relative velocity v changes in the ratio

$$\frac{2}{D}\times\frac{(D+u)\psi(D,u)+(v'-u)f(v',u)}{\left\{\dfrac{r(D+u)\psi(D,u)}{r(D-u)\phi(D,u)}+1\right\}}.$$

Now the "real" relative velocity $(v'-u)$ of Sir Shah Sulaiman changes by 23·7 in the ratio $\dfrac{(D+v')(D-u)}{D^2}$.

Therefore $$\frac{v}{v'-u}=2D\times\frac{\{(D+u)\psi(D,u)+(v'-u)f(v',u)\}}{\{(D+v')(D-u)\}\left\{\dfrac{r(D+u)\psi(D,u)}{r(D-u)\phi(D,u)}+1\right\}}\quad\ldots\ 'b'$$

The above *general* expression has been obtained following Sir Shah Sulaiman's ideas. We shall now get from it the special form 23·9 of Sir Shah Sulaiman and examine the conditions underlying it.

It is at once clear that 'b' will possibly yield 23·9 only when $(v'-u)\,f\,(v',\,u)=v'-u$ and $r\,(D+u)\,\psi\,(D,\,u)=r\,(D-u)\,\phi\,(D,\,u)=r\cdot D$*!

Since

$(D+u)\,\psi\,(D,\,u)=(D-u)\,\phi\,(D,\,u)=D$ is impossible in absolute space and time, the formula 23·9 is untenable. It should also be noted that the related views regarding the nature of relative velocity are automatically disproved.

2. We now pass on to the transformation formulæ developed in item 7, p. 247, Chapter V. It is asserted there that Einstein's assumption that

$$\left.\begin{array}{l}x=0,\,x'=(v'-u)\,t',\\ x=0,\,x=-(v'-u)\,t'\end{array}\right\}\ \ldots\ (c)\quad \text{simultaneously,}$$

where $(v'-u)$ is the difference between velocities of the systems S $(x,\,y,\,t)$ and S' $(x',\,y',\,t')$ involves the grave fallacies, *viz.*, (1) "that their different co-ordinates can be read off instantaneously, whereas if a messenger be employed he will take time to go from one to the other and back, and (2) that these co-ordinates are measured when the two systems are alternatively at rest which is not the true fact."

* The left-hand bracket in the denominator of 'b' deals with *individual* velocities in space.

The "true" transformations for a double journey are given (for the origin) with the help of (23·2) as

$$x=0,\,x'=\frac{(D-u)(D+v')}{(D+u)(D-v')}(v'-u)t'\cdots(A)$$

$$x'=0,\,x=-\frac{(D-u)(D+v')}{(D+u)(D-v')}(v'-u)t\ldots(B)$$

where t and t' are "the whole times taken, in the systems". I beg to point out that the time elapsed has been given a vague meaning. The equations A and B can be examined on this score alone but it is better to deal with them in a fundamental way.

The careful reader will realise that objection (2) has already been disposed of, in its implications, in the foregoing discussion when we set aside the formula 23·9. We shall, therefore, deal at length with objection (1) only.

For convenience and definiteness our attention will be focussed on the equation A.

Now after time t', if we could read off the co-ordinates instantaneously, we would get, by the help of (c) $x'=(v'-u)\,t'$. But the messenger who is moving about with velocity D will find, with the help of 23·2

$$x'=\frac{(D-u)(D+v')}{(D+u)(D-v')}(v'-u)\,t',\ i.e.,\qquad 'A'$$

But this result will be obtained at time t_1', because some time, as is advocated by Sir Shah Sulaiman, has been spent in the to and fro journey. The time *spent* by the messenger is by the help of 23·1

$$\frac{2D\,(v'-u)\,t'}{(D+u)(D-v')}.$$

Hence

$$t_1' = t' + \frac{2D\,(v'-u)\,t'}{(D+u)\,(D-v')}$$

$$= \frac{(D-u)\,(D+v')}{(D+u)\,(D-u)}\,t' \qquad \ldots \qquad \ldots \quad \text{'D'}$$

Now, 'A' is $x' = \dfrac{(D-u)\,(D+v')}{(D+u)\,(D-v')}\,(v'-u)\,t'$

and 'D' is $\dfrac{(D-u)\,(D+v')}{(D+u)(D-v')}\,t' = t_1'$.

Therefore, $x' = (v'-u)\,t_1'$.

We thus get $x' = (v'-u)\,t_1'$, which is exactly of the type (*c*) and, of course, immediately yields it—a relation we set out to supplant.‡ There is nothing mysterious in this anti-climax. By accepting the fundamentals of classical Physics (such as absolute space and time, definition of motion, etc.) the results which were to be superseded were dormant in our manipulations and a thorough investigation has naturally revealed the vicious circle.

The beauty of the argument lies in the fact that t_1', is *naturally* equivalent to

$$\frac{(D-u)\,(D+v')}{(D+u)\,(D-v')}\,t'.$$

The results 'A' and 'B' were there because though we had re-evaluated distances in accordance with our new conception of messengers travelling with finite velocities, we did not do that with regard to time.

3. *Gravitation.*—

It is asserted by Sir Shah Sulaiman on p. 148, Chap. VIII, that Newton regarding the speed of gravitation to be infinite would assume the attractive pulls on the planet to act at P_1 and P_2, etc.; but because of the finite velocity of gravitation the pulls really act at P_1', P_2', etc., and as a consequence, the magnitude of the pulls is decreased in the ratio

$$\frac{1}{\left(1+\frac{\delta r^2}{r}\right)} = \left(1-\frac{1}{D}\cdot\frac{dr}{dt}\right)^2.$$

But a most interesting point has been overlooked.

Now, as gravitation is supposed to travel with the huge velocity D, it has long ago spread all over the solar system (and indeed far and wide) and the planets are simply passing through a sort of "static" field. There is no question of gravitation overtaking them and the factor $\left(1-\frac{1}{D}\cdot\frac{dr}{dt}\right)^2$ is merely illusory and unconnected with physical reality. It should be remembered, in this connection, that it is universally held to be inadmissible to base any precise scientific investigations on arbitrarily assumed conditions at the time of Creation.

4. In the *Proc. Nat. Acad. Sci. India*, Vol. 6, Part 4, p. 269, *et seq*, Sir Shah Sulaiman has presented a newer derivation of his modification of the Newtonian law of gravitation. Apart from general objections, this derivation seems to be fallacious in itself. For the following discussion kindly refer to the top of p. 275 and also the bottom of p. 277.

The elements of a particle unaffected by gravitation are, at any point, during a short time *dt* considered as dx^2, dy^2, dz^2, $-v^2dt^2$ *or* dx^2, dy^2, dz^2, $\frac{v^2}{D^2}\,dw^2$ where $dw^2 = -D^2dt^2$ is a *substitution*. Under the influence of gravitation the fourth element is given to be $\left(\frac{v^2}{D^2}+W\right)dw^2$. Now when $A\times B = C\times D$ then $(A+L)\,B = (C+\gamma)\,D$ only when $\gamma = \frac{B}{D}$ and as $\frac{v^2}{D^2}\,dw^2$ is merely a *substitution* for $-v^2dt^2$ the fourth element is to be $\left(\frac{v^2}{D^2}-\frac{W}{D^2}\right)dw^2$ whose introduction makes the speed of gravitation irrelevant, and it is only natural that it is so for a particle under the influence of gravitation *at a point* cannot betray the effects of the *speed* of gravitation.*

ZAHUR HUSAIN.

Amritsar,
September 24, 1937.

‡ Of course at time t_1', the ordinary procedure adopted in Relativity gives the same result $x' = (v'-u)\,t_1'$.

Sir S. M. Sulaiman, *Proc. Nat. Acad. Sci.*, U. P., India, Vol. IV (July 1934), Vol. V (Feb. 1935), Vol. V (December 1935) and Vol. VI (November 1936).

* Of course, the form 'W' *itself* which represents the superposition of gravitational influence is arbitrary subject to the *elementary* conditions of similarity of treatment in the four variables arising out of the nature of influence superposed.

REVIEWS.

Carl Friedrich Gauss.—Inaugural Lecture on Astronomy and Papers on the Foundations of Mathematics. Translated and edited by G. Waldo Dunnington. (Louisiana State University Press), 1937. Pp. 91. Price $1·00.

This little volume of about 90 pages, dedicated by the author to the Rector, Dean, Curator, and Profs. Hasse and Kienle of Göttingen University on the occasion of its Bicentennial Jubilee of 1937, contains a short account of the early life of Gauss put together by the author from study of new data, papers by Gauss on foundations of mathematics and an inaugural lecture by him on Astronomy. Both the latter are collected here for the first time.

The author is a great Gauss enthusiast. He has spared no pains in looking out numerous Gaussian *Archives* and other independent sources for material of his biography. In his own words "it is unnecessary to justify the publication of anything from the pen of a man who ranks with Archimedes and Sir Isaac Newton as one of the three greatest mathematicians of all time." As a result of the author's investigations many new incidents of the first twenty-six years of Gauss' life have been brought to light—in particular, the great friendship of Gauss and Bolyai is vividly portrayed here in its serious as well as gay aspects. A few interesting facts may be recorded here:

"From childhood to old age Gauss always used the empty pages and the inside of the book covers as writing paper, not only for the entry of formulas often used and of occasional minor calculations, but frequently also for abstruse researches."

"He (Gauss) was very modest and didn't make much showing; not three days as in the case of Plato, *for years one could be with him without recognizing his greatness.* What a shame, that I didn't understand how to open up this silent 'book without a title' and read it."

"Gauss never liked to teach, because it robbed him of time for research. According to his notions the ideal plan would be to lecture on research in which one might be engaged at the moment or in which one might be specially interested. Nevertheless we know that Gauss was a great teacher."

The inaugural lecture on Astronomy is a masterpiece of presentation, of clearness and precision of thought and might well be taken as a model for an introductory lecture. Even after the lapse of 130 years the lecture appears quite fresh and could well be delivered (with minor alterations) to audiences of the present day to explain the importance of a study of Astronomy. In view of recent developments in Astrophysics the following short extract from Gauss' lecture appears extraordinarily interesting:

"nevertheless one finds that some writers—to be sure only such ones for whom physical astronomy is a *terra* incognita—use the word physical astronomy in an entirely different sense and understand by it the little that we know about the physical constitution of celestial bodies, their surface, atmosphere, and about sun-spots, etc., the little, I say, that we know about these subjects and the much that is supposed and dreamed, feigned and blundered. It is always well to know this solecism because otherwise ridiculous misunderstandings can arise."

All lovers of Gauss—and all mathematicians will surely read this book from cover to cover.

B. S. M.

Scripta Mathematica Forum Lectures. (Published by Yeshiva College, New York), 1937. Pp. 94.

This is a collection of four lectures delivered before the Forum of the Friends of *Scripta Mathematica* by C. J. Keyser, D. E. Smith, E. Kasner and W. Rautenstrauch. The lectures are entirely non-technical in character and but for the fact that they deal with mathematics directly or indirectly they do not presuppose any knowledge of mathematics on the part of the reader.

The first lecture by Keyser on "Mind the Maker" is an essay due to William Benjamin Smith on the questions of Reality and

the World and discusses the philosophic bearing of the results of modern physics. It is remarkable as much for its brilliant and original ideas as for its powerful—almost thunderous—literary style. But for the extremely valuable *résumé* given at the end of the lecture it would be difficult indeed to understand what exactly are the author's conclusions. Here are a few characteristic statements "an absolutely hopeless equalitarianism of the atoms" when referring to the "Heat death"—"The highest conceptional ecstasy, the reverie of a mystic, the aspiration of a philanthropist, the musing of a sage, the imagination of an artist or poet, the observation or calculation of a savant—none has ought physical about it,....; for the subject in each case the experience is purely psychic."—"We may liken Psyche to a boundless flag floating in the breeze, full of crinkles, in number infinite, endless in variety. Each of these flexures is itself and not another, each what is only as the others are what they are, each mysteriously joined with every other, *so* as for All to form One, the whole, whence one might say that Each is identical with the Whole, extending its being through Infinite." One can hardly fail to wonder if, in these last sentences, the author is really not translating into English some Sanskrit stanzas from out of our Indian Upanishadic philosophical systems!

The second lecture on a brief history of mathematics by such a well-known authority as D. E. Smith gives a rapid sketch based on the chronological order of the most striking contributions to mathematics. It traces the trends of mathematical developments in several countries and assigns the causes leading to such developments. It is very interesting to read "To what country should be credited the work of Lagrange who was of French descent, an Italian by birth, German by adoption and Parisian by choice?" Of particular interest to us is the statement "Is all this period (16th–19th century) the orient, and particularly Japan and India, did little except as it followed European leads." Contrast this with the three places assigned in Prof. Smith's roll of giants to three Indian mathematicians, *viz.*,

"510 : Aryabhata the Elder—850 : Mahavira—1150 : Bhaskara."

The third lecture on "New Names in Mathematics" by Kasner is, in our opinion, the best of the four. Prof. Kasner has discovered a remarkable method of presenting to a lay audience some of the abstruse topics in mathematics. He has divised some very fine names like "turbine," "cycle," "parhexagon" and the best of the lot "the googol" a short name for the big number 10^{100}. We are not quite sure if Prof. Kasner is right in saying that there is only one cycle touching three given cycles. We think it ought to be two cycles. We can add a few more names to his list—a street, a tree, a hole, a sink, a signature. To illustrate the abuse of the word '*simple*' he cites a simple group which is a 'group without any self-conjugate sub-groups'. How much simpler this is when compared with "simple-algebra," *i.e.*, an algebra which is not nil-potent and has no maximal nil-potent invariant sub-algebra and in addition has no invariant sub-algebra!

The last lecture is on Science in relation to social growth and economic development and deserves to be read by every politician with great care. Only one striking sentence we shall extract here "our failure to apply the methods of Science to the design and construction of an economic system adapted to the requirements of this power age must be classed along with the declarations of war as among the major stupidities of the human race."

B. S. M.

Protective Films on Metals. By Ernest S. Hedges. (Chapman & Hall, Ltd., London), Second and Revised Edition, 1937. Pp. 397. Price 21*sh.* net.

The importance of a publication on the interesting subject of protecting metals against corrosion is easily gauged from the fact that there is hardly any industry or operation on a large scale in which metals are not employed. For a long time research workers in academic institutions have been aware of the part played by films in rendering certain metals immune from the corrosive action of air and chemicals. The most outstanding example of this behaviour is the phenomenon of passivity which has attracted a great deal of attention both from the academic and the practical scientist. These investigations have led to the introduction of new products which are of great interest and utility. As an example of this may be mentioned the following: stainless steel, decorative oxidised copper, and brass, chromium, nickel, silver and

gold-plated articles, and the tin plate container of the canning industry. Many new processess have been invented to achieve this object and to the old methods of electrodeposition may now be added the hot-dipping, spraying, cementation and sputtering methods, all of which find application in art and industry.

This monograph deals in a fairly exhaustive manner with the practical side of the subject in five chapters. Iron is certainly the metal which finds by far the greatest use in industry and its protection has been one of the oldest problems in chemistry. One is familiar with the use of inhibitors such as sodium hydroxide, carbonate, silicate or oxide and ordinary agents such as potassium chromate which impart resisting qualities by forming a protective film. This monograph gives a detailed account of various other methods such as case-hardening by nitrogen, the coslettising process, the parkerising process and the bonderising process and deals with various methods of obtaining stainless steel. The other metals which have been dealt with are aluminium, magnesium, copper, tin and silver.

The metals, aluminium and magnesium and their alloys, have acquired special significance owing to their use in air-craft and marine air-craft. The protection of aluminium owes much to the early investigations of Seligman and Williams. They showed in 1920 that this metal acquired enhanced resistance to corrosive action when treated with ammonia, sodium phosphate and sodium carbonate. They further showed that the cleaning of aluminum utensils by soda can be accomplished without much harm to the metal if a small quantity of sodium silicate is added to it. This is probably due to the formation of a protective film of aluminium silicate. Amongst the more well-known processes for this purpose are the Jirotka process and the modified Baur-Vogel process popularly known as the M. B. V. Process. In the Jirotka processes the films are obtained by the use of aqueous solutions of chromates and salts of heavy metals and in the Baur-Vogel process the use is made of a hot solution of potassium carbonate and sodium and potassium bicarbonates in presence of suitable catalysts.

The book deals with technical matters of this kind in a language easily understandable even by the layman and the chemist not familiar with works practice. The book is not intended to be a dictionary, but one would have been pleased to see in this book some references to the corrosive action of acetic acid on copper and the exhibitors which have been proposed besides the nitrogen blanket. This corrosion has acquired some importance owing to the phenomenal developments in artificial silk industry and the use and recovery of acetic acid involved in the manufacture of this commodity.

The theoretical treatment of the subject is also refreshingly simple and no chemist can say that mathematical or engineering complexities have been introduced to make the reading boring or cumbersome. What is more, the treatment is sufficiently detailed so that real knowledge is imparted to the reader. The anodic passivity, a phenomenon of baffling interest has been treated beautifully and is specially commended to the intending reader. It is altogether an excellent addition to physico-chemical literature dealing with industrial problems.

S. S. B.

The Low Voltage Cathode-Ray Tube and its Applications. By G. Parr. (Chapman & Hall, Ltd., London), 1937. Pp. 177. Price 10*s*. 6*d*.

This book is intended to give an insight into the tube and its technique. It is written by a member of the Radio Division of the Edison and Swan Electric Company.

The deflection of a cathode-ray beam by a charged plate enables the potential of the charge on the plate to be determined if the potential drop used to produce the beam is known. The potential drop is a measure of the energy of the electron beam. In high voltage tube, the potential drop is some 60 kilovolts. The tube in this case is generally permanently connected to a pump system to produce the necessary high vacuum, and is provided with an arrangement for holding photographic recording plates. In medium voltage tubes the potential drop is from 1 to 3 kilovolts. No provision is made for insertion of photographic plates in these. The energy giving device, the deflecting plates as well as the sensitive fluorescent screen are all contained in vacuum in a sealed glass vessel of conical shape and long neck. The low voltage tubes work with energising potentials of about 500 volts and contain traces of gas which enable a sharp spot

(focussing) to be got on the sensitive screen in the flat part of the conical flask, at the place where the beam strikes the screen. These tubes are called "soft" as contrasted with the medium tubes which are sometimes referred to as "hard", *i.e.*, not containing gas.

The cathode-ray beam passes through two pairs of parallel deflection plates, sometimes called deflector plates, placed one behind the other in planes at right angles to each other. In Chapters I and II are discussed the details of construction, the principles and the various methods employed in the production of narrow beams of the ray. Details are given of the focussing by the magnetic and electrostatic methods in addition to that of gas focussing referred to above.

Chapter III is devoted to an account of the pattern described by the cathode-ray spot on the fluorescent screen when various deflecting voltages are applied to the two pairs of deflectors, the deflecting potentials are sinusoidal and of the same frequency but of different phases and amplitudes, or sinusoidal in one pair and non-sinusoidal in the other, or sinusoidal in both but of different frequencies; these are discussed with a view to enable the tube to be used as a frequency meter.

The observation of potential variations in their true relations to time, requires a uniform movement of the beam in a horizontal plane with a rapid return to its initial position at the end of its travel, *i.e.*, a linear time base (L.T.B.). The majority of the L.T.B. circuits depend for their action on the charging of a condenser through a resistance, the condenser being discharged at given intervals of time by short circuiting. The horizontal deflectors of the tube are connected across the condenser and thus have, applied to them a gradually increasing potential which abruptly falls to zero. Neon lamps (with or without amplification) and other gas-filled tubes as well as mercury vapour relays called thyratron (triode valves filled with mercury vapour) are used for short circuiting. Circuits are given in Chapter IV for varying the range of the L.T.B. and for synchronising or locking of the test voltage impulses with the time base.

Time bases other than linear are sometimes useful as in the study of audio-frequency wave-forms where a sinusoidal time base obtained from an A.C. supply is used. Elliptical movement of the beam can be obtained by applying the voltages to the two sets of deflectors, for one directly and for the other through a phase splitting device got by the use of a high resistance and a condenser in series, the ends of the condenser going to the second pair. The unknown frequency can be superimposed on one of the pairs of plates and a ripple like variation will be superimposed on the elliptical trace. The number of the ripples will give the factor by which the known frequency has to be multiplied to give the unknown frequency. By making the high resistance equal to $1/C\omega$ the potentials applied to each pair of plates become equal and we get circles on which the superimposed ripples could be measured with greater ease, and with an accuracy surpassing that with Lissajous' figures since the number of ripples on the circumference are easily counted. The case of using magnetic deflection simultaneously is also discussed.

Arrangements are discussed for study of transient wave-forms or spark discharges. Beam traps enable the beam to be released for observation of the pattern just before the incoming of a transient, in that a deflecting field is cut off to enable the beam to traverse the hole in the anode. Double cycle wave recording is also possible. Chapter VI is devoted to the applications to Radio engineering and Chapter VII for applications in other industries, etc., as pressure gauges by piezoelectric means, for measurement of hysterisis of magnetisable materials, for recording of heart beats, etc. Chapter VIII is devoted to the use of the tube in television. There is a good Bibliography. The get-up of the book is excellent.

B. DASANNACHARYA.

Quantitative Analysis. By Willis Conway Pierce and Edward Lauth Hœnisch. (Chapman and Hall, Ltd., London), 1937. Pp. 412. Price 15*sh.* net.

This book on quantitative analysis is to be confidently recommended for the beginners; its lucid exposition, simple, concise and unambiguous treatment of the subject-matter, careful presentation and judicious selection of topics make it eminently suitable for them. Theoretical principles involved, have been described clearly,

following a brief description of each method. Methods of calculation and description of laboratory procedures are added hereafter. A section of explanatory notes follows each procedure. This serves to correlate the theory and practice, explains the essential points and emphasises the precautions needed. Repeated stress is also given upon the details of laboratory technique in these notes. A list of probable general error is given in the preliminary discussion of each analysis and a list of special errors, that are likely to occur, is added after each procedure following the notes. Students are thus warned to guard against these in the actual course of analysis. Questions and problems at the end of each chapter forms a special feature of the book. This enables the biginners to gain a thorough grasp of the theory and the practice of each analytical method. Advanced theories have also been discussed after certain laboratory procedures in a way that is sure to appeal to the beginners.

The book is divided into four parts, each forming a unit by itself and can be studied independently of the others.

Part I, after giving some general directions, deals with the use of analytical balance. This is followed by a discussion on precision, errors, and significant figures.

Part II is devoted to volumetric analysis in all its aspects, *e.g.*, neutralization, oxidation—reduction and precipitation.

Gravimetric analysis is dealt with in Part III. After discussing the theory of precipitation, which includes the study of solubility product, properties of colloids and the phenomenon of co-precipitation, general operations of gravimetric analysis are described. This is followed by analysis of simple mixtures and a detailed account of the complete analysis of a typical rock like limestone.

As is to be expected in an elementary text-book, the authors do not aim at a comprehensive description of all types of mixtures and minerals. But a mastery of the technique and procedures of those described in the book will provide the students with sufficient equipment to carry out analysis for any other mixture or mineral with the help of a suitable reference book only.

Part IV, which constitutes the last section of the book, deals with certain special methods of analysis, such as analysis by electro-deposition, electrometric titrations and colorimetry.

A chapter on the use of analytical literature and a very short general account of certain other special methods of analysis completes the book.

It is a pleasure to read a book of the type under review. It should serve as a companion book for students in the undergraduate course and a guide for the teachers. The authors, who are themselves teachers of considerable experience, have very successfully dealt with the difficulties that a beginner in analytical work often experiences.

The book cannot be too highly recommended for the undergraduate students of our Indian Universities.

Finally, the reviewer would like to draw the attention of the authors to a very few inaccuracies or ambiguities in this excellent book. These are enumerated below :—

On p. 82, "Moles of solute = Molarity × Milliliters solution" should be Millimoles of solute = etc., etc.

On p. 148, the development of the conception of valence number and its explanation is not very happy and straightforward. To assign a valence number of 3 to the carbon atoms of oxalic acid sounds rather strange, if not confusing. Representation of the reaction between permanganate and oxalic acid in acid solution, appears also to be very complicated, and is likely to confound the beginners. A much better and clearer method of representing oxidation processes is to be found in many German text-books.

On p. 204, line 10 from the top, '5 m. mol. Fe^{+++}' should be substituted by '5 m. mol. Fe^{++}'.

On p. 339, towards the bottom, it is stated that "the deposit should be bright yellow or orange in colour." We have never obtained a bright yellow deposit of copper by electrolysis.

On p. 369, line 8 from the top, it is written under gas analysis that carbon dioxide is absorbed by a solution of sodium hydroxide. Usually, however, potassium hydroxide is employed for the absorption.

These are, however, of minor importance, and it is hoped that they will be rectified in the next edition.

The printing and get-up of the book leave nothing to be desired, but the price is somewhat high.

P. R.

A Text-Book of Qualitative Analysis. By A. L. Vogel. (Longmans, Green & Co., Ltd., London), 1937. Pp. xi + 383. Price 7*s.* 6*d.*

There are many excellent text-books on qualitative analysis and the present volume is merely an addition to the list. The author of this work has produced no "startling new facts" to support novel methods of analysis or introduced anything new into his treatment of the subject.

The first chapter of the book contains a discussion of the theoretical basis of qualitative analysis. It is followed by a short chapter which deals with a description of the various analytical operations involved. Then come two chapters which give respectively the reactions of cations and anions. The next chapter is concerned with the systematic qualitative analysis of inorganic substances. There is then a chapter which is devoted to the modifications necessary in the usual course of analysis on account of the presence of interfering substances, like phosphates, borates, organic matter, etc. The last chapter gives a short account of the reactions of the rarer elements.

The book is well printed and free from errors. On the whole, the book is a good one, complete with a large number of useful tables, and suitable for university students, at moderate price.

R. C. R.

A Laboratory Manual of College Chemistry (Elementary Course). By H. G. Deming. (John Wiley and Sons, New York), 1937. Pp. 286. Price 8*s.* 6*d.*

The author's aim in writing this *Manual*, as stated by him in the preface, has been to provide a course of laboratory instruction to the college student in the first half year of his studies which will enable him to acquire a certain amount of manipulative skill and appreciate scientific method. The exercises, forty-eight in number, include manipulations of glass tubing, preparation of some gases, preperation of some simple, double and complex salts, tests for common anions and cations, study of important reactions of a few elements and compounds, determination of molecular weights by the lowering of melting point, studies in the nature of solvents, hydrates and hydrolysis.

The design of each exercise is very good. The theoretical aspects are well explained first, the exercise is stated and detailed instructions for manipulation are then given, a detachable record sheet—to be handed over to the instructor after the completion of the exercise—for the entry of observations and results by the student put in next and finally a list of questions bearing on the theoretical and practical aspects of the exercise is appended. The questions referred to here are to be answered by the student, after a certain amount of home study in a class specially conducted for the purpose (lecture quizz). This is a special feature of the scheme which is worthy of praise and acceptance. In this and in a few other details, the author has succeded to a great extent in breaking away from the traditional methods of laboratory instruction.

There is, however, a good deal in this *Manual* that is clearly above the heads of students taking an elementary course—this *Manual* is sub-titled an elementary course—in the first semester of their college studies. For example, in the sections on hydrolysis, tests for common ions and double and complex salts, a good knowledge of the law of mass action and ionic equilibria is assumed and cross references to the author's text-books are given for a study of the subject. Again, to understand the section on polar and non-polar solvents and the structure of water the student must be familar with the electronic concept of valence and the significance of dielectric constant. The experiments, quite simple by themselves, are the ones usually carried out by students undergoing an elementary course. The author's anxiety seems to be to illustrate the maximum that could be done from each experiment and hence the theoretical introductions have been made far too heavy for elementary students. This is an aspect which detracts to some extent from the merits of an otherwise admirably conceived plan of laboratory work.

The *Manual* contains plenty of matter to which a college student in the more advanced stage of his studies could advert with advantage for enlightenment.

A. N. K.

Reading, Writing and Speech Problems in Children. By Samuel Torrey Orton. (Chapman and Hall, Ltd., London), 1937. Pp. 215. Price 10*s.* 6*d.*

As reading, writing and speech are some of the most important problems of the intellectual aspects of education, a book of this kind is a welcome contribution to the educational literature of the present day. As rightly pointed out in the foreword, any disorder in the normal acquisition of spoken or written language may prove a great hindrance to academic advancement and it may often be the cause of serious emotional trouble. The studies here recorded may, therefore, be of great interest and use particularly to teachers and parents.

The use of some techincal words at the very outset is rather disconcerting, but the author has anticipated this and provided a brief glossary of such words at the end.

The book consists of three chapters. The first chapter is mainly an exposition of problems, such as word blindness, word deafness and loss of ability to read or write. The second deals with certain disorders in the development of language in children and gives some good instances and illustrations in support of the points made out in the first chapter. The third is an interpretation and treatment of certain of those disorders. One finds in this chapter a clear and well-balanced discussion of the neurological interpretations of the children's disorders and a general review of the principles on which the author's experiments in retraining have been founded. The author's word of caution that " there is no general formula which will be applicable to all cases of any of the syndromes that are discussed " is an obvious proof of the author's objective outlook.

On the whole the book is a real contribution in the field and is well worth being read by all those interested in a study of those problems.

M. S.

The Scientific Journal of the Royal College of Science, London, Vol. VII. (Edward Arnold & Co.), 1936. Pp. 146. Price 7*s.* 6*d.*

The Journal contains extremely interesting and important papers, some of them presenting results hitherto unpublished.

The Chemical Society Section has contributed four papers, these being (1) " Applied Science " by Prof. A. C. G. Egerton, (2) " Catalytic Activation of Hydrogen" by Prof. M. Polanyi, (3) " The Structure of Polish " by Prof. G. I. Finch, and (4) " The Natural Coumarins and their Effect on Fish" by N. Platzer.

The Natural History Section has four papers to its credit, these being (1) " Some Aspects of Clay Chemistry " by A. Brammal and J. G. C. Leech, (2) " Plant Poisons " by C. L. Mer, (3) " The Habits of Wasps " by O. W. Richards, and (4) "Virus Diseases in Relation to Strawberry Cultivation " by R. V. Harris.

The Mathematical and Physical Society Section has contributed three papers: (1) " The Development of the Photographic Latent Image " by Associate-Prof. R. Kingslake, (2) " Applications of the Thyratron " by C. E. Wynn-Williams, and (3) " Theories of the Photographic Latent Image," by Prof. N. F. Mott.

The printing of this journal is excellent and the binding very attractive. There is no doubt that this journal will be read with great interest by every scientific worker.

K. R. K.

La Fin de la Physique mécaniste, par Philipp Frank. (Actualités scientifiques et industrielles, No. 414.) (Hermann et Cie, Paris), 1936. Pp. 57. Price 10 *fr.*

This is a vigorous protest against the unwarranted extension of purely physical ideas and phrases to other branches of knowledge. In agreement with Planck, the author assures us that modern Physics has not by any means proved the theory of Free Will, and its methods and equations are no more " organistic " nor any less " mechanistic " than before. What has been learnt is that the laws deduced from observations of large bodies with low velocities are not applicable to minute bodies and large velocities. Bohr's extension of the idea of ' complementarity ' to psychology is shown to be of no value since psychologists have long before realised that experimental psychology cannot be based on introspection. The author concludes that such misconceptions are due to the loose usage of words having a definite technical meaning in one science in popular expositions involving excursions into other sciences. The remedy suggested by him is

to have a phraseology which has the same meaning in all the sciences. The book must be read by all who are interested in finding out the real significance of the discoveries of modern Physics in shaping our attitude to various problems of life.

Cinétiques des Réactions Nucléaires, par G. Gamow. (Actualités scientifiques et industrielles, No. 349.) (Hermann et Cie, Paris), 1936. Pp. 23. Price 8 *fr.*

This little book contains a useful discussion of various types of nuclear reactions. The theoretical expressions for the probabilities of the reactions are not derived but only discussed in a qualitative way. The value of the book would have been enhanced if a bibliography were included giving references at least to those papers where the theoretical expressions used are derived. Equations IV and IV′ on p. 11 contain symbols having confusing positions for Z and N. Thus IV which reads

$$_{197}Au^{79} + {}_{0}n^{1} \rightarrow {}_{196}Au^{79} + h\nu$$

should be $_{79}Au^{197} + {}_{0}n^{1} \rightarrow {}_{79}Au^{198} + h\nu$.
In Eq. VII on p. 13, $_{7}B^{11}$ should be $_{5}B^{11}$.
Eq. XII is wrong.

Théorie de l'Émission des Rayons Alpha à travers une double Barrière de Potentiel, par Théodore Kahan. (Actualités scientifiques et industrielles, No. 406.) (Hermann et Cie, Paris), 1936. Pp. 31. Price 12 *fr.*

This brochure contains a good account of Gamow's theory of the emission of α-particles from radioactive nuclei. A solution is also given of the somewhat academic problem of a double potential barrier traversed by an α-particle, with some simplifying assumptions. The application of this discussion to an actual case is not clear. Since the existence of α-particles inside nuclei is not usually admitted in modern researches on nuclear structure, we are not sure of the present position of Gamow's theory. Any new discussion of the problem should make this position clear, but the present account does not attempt this task.

Nouvelles Recherches sur la Lumière, par L. de Broglie. (Actualités scientifiques et industrielles, No. 411.) (Hermann et Cie, Paris), Pp. 55. Price 12 *fr.*

We must be grateful to the distinguished author for making his interesting theory of light accessible to a wider circle of readers. The theory is not yet entirely free from difficulties. In spite of the attention attracted by the alternative theory of Jordan and Kronig, de Broglie has elsewhere shown that that theory is difficult to believe in for various reasons, and his own theory retains its interest unabated. The present exposition incorporates a number of improvements over the earlier account in Actualités scientifiques et industrielles, No. 181, 1934.

Report of the Proceedings of the 13th Conference of the Association of Special Libraries and Information Bureaux, London, 1936, 8vo. Pp. 135. Price 5*s*.

This interesting annual keeps up its established standard. The papers, thirteen in number, are printed in extenso and are supplemented by a brief summary of the discussion that followed their presentation. As usual, a brief survey of the work of the Association is given at the beginning.

The main topic chosen for discussion at the Conference was school libraries. Accordingly, five of the papers deal with different aspects of that subject, in addition to the Presidential Address itself having been on "The Library in the School". All the papers start with the recently laid emphasis on "Individual Instruction" and "Education through Self-help and Experience" and work out the lines along which school libraries should organise their work so as to serve these ideas.

Other topics include classification and utilisation of Government publications and the indexing of abstracts and research data. Mr. M. R. Kalyanaraman, Librarian, Industrial Research Bureau, India, has sent up a a paper entitled "Organisation of Industrial Intelligence in India", to which is appended a nearly exhaustive list of the periodical publications issued by the Government of India.

S. R. R.

CENTENARIES

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Neile, William (1637-70).

WILLIAM NEILE, the Britsh Mathematician, was born December 7, 1637, at the palace, at the Bishopthorpe, of his grandfather, Richard Neile, who was Archbishop of York. He entered Wadhalam College, Oxford, as a gentleman-commoner in 1652 three years before matriculating.

Early Promise

Even in that early age he displayed mathematical genius. Although he entered the Middle Temple in 1657, his interest in mathematics persisted. In that very year when he was still under 20, he "found out and demonstrated a straight line equal to a paraboloid; and communicated the same to others who used to meet at Gresham College" before the institution of the Royal Society. Lord Brouncker communicated the demonstration to Dr. Wallis, who published it in his *De cycloide* in 1659. A bitter controversy regarding the priority of this discovery arose in 1673 when Huygens stated in his *Horologium oscillatorium* that it was first discovered in 1659 by John Hauraet of Harlem.

Premature End

Neile was elected a Fellow of the Royal Society in 1663 and a member of its Council in 1666. He developed a theory of motion and communicated it to the Royal Society in April 1669. He also conducted astronomical observations in a private observatory built on the roof of his father's residence. He belonged to the Privy Council of Charles II. According to Hearne, "deep melancholy hastened his end, through his love for a maid of honour, to marry whom he could not obtain his father's consent." Thus "the further expectations, which had been conceived of his genius in mathematical and philosophical subjects, were disappointed by his early death, which happened on the 24th of August 1670".

Davies, Thomas (1837-91)

THOMAS DAVIES, the British Mineralogist, was born December 29, 1837, in the parish of St. Pancras. His early education was of a very elementary character and the period of his school life was brief. Being of a roving disposition, and finding town life irksome, he took to sea at the age of fourteen and during the next four years led a roving life visiting India among other countries. He was then prevailed by his father to adopt a more settled mode of life.

His Career

Accordingly, he entered life in 1858 as an attendant in the Mineral Department of the British Museum under Professor Maskelyne and was promoted junior assistant in 1863. For nine years he was the only assistant and in the arrangement and labelling of the immense mass of specimens under the Professor's supervision, he acquired an eye-knowledge of knowledge which has rarely been surpassed. Subsequently, he acquired an equally sound knowledge of the microscopic characters of rock-forming minerals.

His Honours

In 1880 Mr. Davies was promoted to the grade of first class assistant and by a singular coincidence his father obtained similar promotion in another department of the British Museum on the very same day. In that year Mr. Davies was awarded the Balance of the Proceeds of the Wollaston Fund "as a testimony of the value of his researches in Mineralogy and Lithology". He was a foundation member of the Mineralogical Society, and editor of the *Mineralogical magazine* for some years.

Daviesite

In 1889 the name of Daviesite was given to a new mineral "in honour of Mr. Thomas Davies who has now been associated during upwards of thirty years with the British Museum Mineral Collection and whose Mineralogical experience and Breithauptian eye have ever been willingly placed at the service, not only of his colleagues, but of everyone who has been brought into relationship with him".

He died after some months of failing health on December 2, 1891.

Schrauf, Allrechte (1837-97)

ALLRECHTE SCHRAUF, the Austrian Mineralogist, was born December 14, 1837. He became an assistant in the Mineral Department of the Imperial Museum of Vienna in 1861 and became keeper in 1867. In 1877 he retired from the Imperial Museum and became Professor of Physical Mineralogy in the University of Vienna and remained as such till the end of his life.

HIS CONTRIBUTIONS

His chief publications were *Treatise on physical mineralogy* (1866–68) and *Precious stones* (1869). His chief interest was in the general problems connected with atoms and molecules and their relation to the physical characters of crystals. His hobby lay in the mechanics of crystal drawing and he undertook to prepare an Atlas of the crystalline forms of all mineral species. But the publication was discontinued before reaching letter D.

Prof. Schrauf died on November 29, 1897.

ASTRONOMICAL NOTES.

Planets during January 1938.—Mercury will be stationary on January 9 and will reach greatest elongation 24° W. on January 20. It can be seen low down in the sky near the western horizon soon after sunset. On January 29, there will be a conjunction with the moon, the planet being at the time, 3° 28′ south of the moon. Venus will be too near the Sun during the month to be easily visible.

Mars is slowly moving towards the Sun and can be seen in the western sky for some time after sunset. Jupiter is getting close to the Sun and will not be in a suitable position for observation. The planet will be in conjunction with the Sun on January 29. Saturn will be situated east of Mars and will continue to be in a convenient position for observation in the early part of the night. The rings are gradually widening the length of the minor axis being 2″·50 at the end of the month. Uranus will be crossing the meridian at about 7 p.m. and can be easily observed ; it is about 10° to the south-east of the bright star α-Arietis.

Comets.—Encke's Periodic Comet (1937 *h*) is within reach of moderate instruments. It will pass perihelion on December 25, its distance from the Sun being only ⅓ of an astronomical unit (mean distance of the earth from the Sun). The comet will be situated in the constellation Ophiuchus and although it may be fairly bright at the time, it will be difficult to observe on account of the evening twilight.

The other comets discovered this year have become very faint and can be seen only with powerful telescopes.

Minor Planets.—Considerable interest is attached to the minor planet Eros on account of the fact that at certain times it approaches the earth nearer than any other superior planet. Eros was in opposition to the Sun on November 27, but its closest approach to the earth will take place in January 1938. At the end of December, it will be in the constellation Perseus and the magnitude at the time being 8·5, the asteroid will be vissible in small telescopes.

Object Reinmuth.—Information has been received of the discovery on October 28 of an interesting object of stellar apperance by Reinmuth at Heidelberg ; the hourly motion being as great as 21 minutes of arc. The object has been observed at some places since then and from the orbits computed, the mean distance from the Sun is found to be 1·8 astronomical units and eccentricity 0·66. The computations indicate that the object was nearest the earth on October 30 ; it was of magnitude 5·5 at the time but has since become very faint.

ARCHAEOLOGICAL NOTES.

Some More Pallava Temples at Kāñci.

IT is a well-known fact that Kāñci or Conjeevaram was the capital of the Pallava Kings between the 3rd and the 9th centuries A.D. No other place affords greater facilities for a study of the structural monuments of the Pallavas than Kāñci. A systematic survey of about half a dozen important temples has been made by Alexander Rea in his *Pallava Architecture*. And though there are a few more temples in the same locality belonging to the same period they do not seem to have been noticed or described in any publication so far. And of these, two in particular are of especial importance. They are respectively, the Vāllīśvara temple and the Iravāsthānēśvara temple.

The Vāllīśvara temple is situated on the west of a tank inside the Ēkāmbarēśvara temple. This is a very pretty mono-celled shrine facing west. The basement is built of granite and the superstructure is constructed of sand-stone as in the case of the Kailāsanātha temple. An examination of the interior of the temple will at once reveal that the temple is Pallava both from the presence of the prismatic *linga* inside it with thirty-two facets, as well as from the panel behind the *linga* depicting Śiva and Pārvati seated side by side.

One point which may be considered here is the absence of the Avadaiyār for this *linga* as in the case of the *lingas* found at the Kailāsanātha as well as in the Shore

temple at Māmallāpuram both of which were built by the Pallava king Rājasimha. The size of these *lingas* also agree and remind one of the style adopted in the early Pallava period for the construction of a *linga*.

One peculiarity with regard to the panel found behind the *linga* is that it does not represent the usual Sōmaskanda motif adopted in the time of Rājasimha but, instead, we have Śiva and Parvāti seated in the same manner as in the Sōmaskanda motif but without Skanda in the middle. Śiva is seen here holding a *triśūla* in one hand and a *kapāla* in the other; Pārvati has also a *triśūla*. And the whole group is interesting iconographically.

On the outer walls of this shrine are seen some inscriptions which are unfortunately obliterated; and if an attempt is made to decipher these inscriptions some light can be thrown on the age of this temple. But judging from the architectural style and the motifs adopted in the construction of this shrine there can be no doubt that it belongs to the first quarter of the eighth century A.D.

The Iravāsthānēśvara temple is situated at Konērikkuppam in Kāñci. This is again a mono-celled shrine facing east and has a small *Ardhamaṇḍapa* in front. The body is built of granite and the tower of sand-stone. It has a square *sikhara* surmounted by four bulls one on each corner.

The *Ardhamaṇḍapa* treasures two very valuable and magnificent reliefs one on either side of its walls; and they depict Śiva as Rāvaṇānugrahamūrti and Ūrdhvatāṇḍavamūrti respectively. Since these reliefs are fortunately not disfigured by white-wash or paint the beauty of these sculptures is seen in all its pristine glory.

Lack of any inscription in or around the temple makes precise dating difficult. But depending again on the architiectural style the prismatic *linga*, the lion pillars and the Sōmaskanda motif of this temple, it will enable one to assign it to the second half of the eighth century A.D.

Though the Vāliśvara and the Iravāsthānēśvara temples described above appear very modest in size when compared to the two great Pallava temples at Kāñci, namely, the Kailāsanātha and the Vaikuṇṭhaperumāḷ, yet they are no less inferior in value from the point of view of architectural and sculptural details.

E. MEENAKSHI.

Theory of Relativity.

IN view of the great deal of literature that is being published recently criticising Einstein's Theory of Relativity, the following abstract from an article of Evershed (*Observatory*, No. 761, Vol. 60, Oct. 1937, p. 266) on the problem of the red-shift in the solar spectrum may be of interest to readers of this journal:—

"In the 'Proceedings of the National Academy of Sciences of India' (Vol. 6, 1936) and in the 'Indian Physico-Mathematical Journal' (Vol. 8, 1937), Dr. Sir S. M. Suleiman has propounded a new theory of light, according to which a light corpuscle consists of a binary system with components of equal mass and opposite charges, rotating round each other and travelling with the velocities of light. One consequence of this theory is that the spectral shift at the edge of the sun should be twice the Einstein value. Another makes the deflection of light of stars past the sun to be between 1·3 and 1·5 times the Einstein value. These predictions might be thought to be confirmed by my measures of the iron lines in the red, and by Freundlich's observed value of the deflection of stars near the edge of the sun. But, it does not seem probable that all the lines of iron are subject to a shift which is twice the Einstein value, and we have to consider also the lines of other elements than iron. I have found from recent measures of the sodium D lines that the displacement at the limb of the sun and at the centre, and presumably over the entire disc, has precisely the Einstein value of + 0·0145 A. These lines represent a high level in the reversing layer, and are therefore not subject to the outward movement of the lower gases, but there is no excess at the limb."

"There can be little doubt that the Einstein-effect accounts for most of the shift in the solar spectrum. Were we situated on the planet Pluto, instead on the Earth where we can observe the sun in detail, we should certainly be satisfied about general relativity, for although we should get a medley of shifts in the spectrum of the star-like sun, as we do here in general sunlight, the mean of all would be close to the predicted shift, and the differences could be readily explained by radial movements of the solar gases, as shown by St. John."

"The limb effects remains, however, an unsolved problem....."

RESEARCH ITEMS.

The Determination of Some Combinatory Numbers concerning Groups, Graphs and Chemical Compounds.—Polya [*Acta. Math.*, B. 68, (3–4), pp. 145–253] has solved very interesting problems in this extensive article which are of great value for the organic chemist. Cayley had determined the number of topologically distinct graphs which has been generalised in a very extensive manner by Polya. The fundamental mathematical problem which he solves and on which he bases his results concerning the number of structire-isomers and sterio-isomers of some organic compounds is the following :

Let $\phi^{(1)}, \phi^{(2)}, \ldots$ etc., be a collection of packets, [He uses the word figure to emphasise its connection with the applications.] each of which contains a number of red, blue and yellow balls. All of them are supposed to be distinct from one another. Let $\phi^{(\lambda)}$ contain α_λ red balls, β_λ blue balls and γ_λ yellow balls. Let a_{klm} be the number of packets among these such that $\alpha_\lambda = k$, $\beta_\lambda = l$, $r_\lambda = m$. Let A be a permutation group of s elements of order h. Let $h_{j_1 j_2 \cdots j_s}$ be the number of permutations of A of type $[j_1, j_2, j_s]$, *i.e.*, the permutation when resolved into cycles in the ordinary way contains j_r, r-dimensional cycles. Let us consider $[\phi_1, \phi_2, \ldots \phi_s]$ an arrangement of s packets taken out of the given collection of packets, it being understood that a packet of the collection may occur any number of times in this arrangement. Let the total number of red, blue and yellow balls in this arrangement be k, l, and m respectively. Two such arrangements are considered to be equivalent *w.r.t.* A when there exists some permutation of A which carries one into the other. The problem to be solved is the determination of the total number A_{klm} of such arrangements (containing k red balls, l blue balls, m yellow balls) which are not equivalent *w.r.t.* A. For this purpose he considers the series

$$f(x, y, z) = \sum_{(klm)} a_{klm}\, x^k y^l z^m$$

and $$F(x, y, z) = \sum A_{klm}\, x^k y^l z^m$$

and derives the following functional equation between them.

Let

$$\frac{1}{h} \sum_{(j)} h_{j_1 j_2 \ldots j_s} f_1^{j_1} f_2^{j_2} \cdots f_s^{j_s}$$

be called the *cycle-show-er* of the group [called the *haupt-characteristic* in the theory of representation of groups].

Then $$F(x, y, z) = \frac{1}{h} \sum_{(j)} h_{j_1 j_2 \ldots j_s} [f(x, y, z)]^{j_1}$$

$$[f(x^2, y^2, z^2)]^{j_2} [f(x^3, y^3, z^3)]^{j_3} \cdots \text{etc.}$$

By means of this functional equation the coefficients can be determined in a recursive way.

The proof he gives is very interesting and comparatively simple. As a special case of this problem he gives an interesting particular example. Suppose there are 3 red balls, 2 blue balls and one yellow ball. We can place these at the six verteces of a regular octahedron in $\frac{6!}{3!\,2!}$ different ways as is known from elementary permutation theory. Now suppose that we consider two such placings as not distinct if we could turn the octahedron in such a way that the former arrangement goes over into the latter. Then a particular case of this general problem is the determination of the total number of distinct arrangements with the modification. It comes out to be 3.

In a chapter of this article he treats of the problem of the distinct number of trees, *i.e.*, one dimensional graphs which satisfy certain conditions. Thereby he precises various earlier definitions. The structural formula of a chemical compound can be considered as a topological *tree*. It may have to satisfy various conditions. If we consider the structural formula of paraffin, we easily see that if it contains n carbon atoms, it must contain $2n + 2$ hydrogen atoms. The *tree* that corresponds is a *free*-tree, *i.e.*, no single atom in it is specialised. If we consider an alcohol of the form $C_nH_{2n+1}OH$ there corresponds a *tree with a specified root*, where the OH-radical in the structural formula must be considered as the root. He considers the OH-radical as the root. Then there will be three principal branches starting from the carbon atom to which the OH-radical is attached. According as the models we consider are the stereo-models, planar models or the topologically distinct models we have the permutation groups [of the principal branches] to be A_3 the alternate group, Z_3 the cyclic group, or S_3 the symmetric group. The principal branches are considered as the packets of the mathematical problem. It is clear that we have only one variable x instead of x, y and z and both $F(x)$ and $f(x)$ are easily expressed in terms of $r(x)$, $s(x)$, etc. By means of this analysis he obtains a series of interesting functional equations of these functions some of which are given below :—

(1) Let ρ_n be the number of structurally distinct theoretically possible paraffins of the form C_nH_{2n+2} and R_n be the number of structure isomers of the form $C_nH_{2n+1}OH$. Let $r(x) = \sum R_n x^n$. Then we have the following functional equation for the determination of Rn

$$r(x) = 1 + x \cdot \frac{r^3(x) + 3r(x)\, r(x^2) + 2r(x^3)}{6}.$$

ρ_n also can be calculated from $r(x)$ by means of a slightly complicated formula.

(2) Let S_n be the number of stereo-isomers of alcohol of the molecular formula $C_nH_{2n+1}OH$; and Q_n the number of structure-isomers of alcohol of the molecular formula $C_nH_{2n+1}OH$ without any asymetric carbon atom. If

$$s(x) = S_0 + S_1 X + S_2 x^2 + S_3 x^3 + \ldots.$$

and $$q(x) = Q_0 + Q_1 x + Q_2 x^2 + Q_3 x^3 + \ldots.$$

then

$$s(x) = 1 + x \cdot \frac{s^3(x) + 2s(x^3)}{3}$$

$$q(x) = 1 + x\, q(x)\, q(x^2).$$

From S_n and Q_n the number of stereo-isomers of paraffin of the molecular formula $C_nH_{2n+2} = \sigma_n$ and K_n = the number of structure-isomers of

Paraffin C_nH_{2n+2} without asymetric carbon atoms can be easily calculated.

It is interesting to observe that $q(x)$ is also equal to the continued fraction

$$1 - \frac{x}{1 -} \frac{x^2}{1 -} \frac{x^4}{1 -} \cdots \frac{x^{2s}}{1 -}$$

which is easily derived from its functional equation. He has also determined some upper bounds for these numbers and discussed the asymptotic behaviour of these as $n \to \infty$. For this purpose he has denoted the radius of convergence of these power series by k, ρ and σ and has proved at first

$$1 > k > \rho > \sigma$$

$$\sigma > \frac{4}{27}, \text{ etc.},$$

also that each of these functions has only one singular point on their respective circles of convergence, the point being a pole of the first order for $q(x)$ and algebraical branch point for the others. By means of the following theorem, *viz.*,

If $f(x) = a_0 + a_1x + \cdots + a_nx^n + \cdots$

has $x = 1$ as the only singular point on its circle of convergence $|x| = 1$, and in the neighbourhood of 1

$$f(x) = (1 - x)^{-s}\, g(x) + (1 - x)^{-t}\, h(x)$$

where $g(x)$ and $h(x)$ are regular at $x = 1$,

$s > t \geqslant 0$ then $a_n \sim n^{s-1}, \frac{g(1)}{\Gamma(s)}$, [where $g(1) \neq 0$]

he has proved various asymptotic formulæ. Some are given below :—

$R_n \asymp \rho^{-n}\, n^{-\frac{3}{2}}.\ \frac{b}{2\sqrt{\pi}}$ where b is some constant,

$Q_n \asymp k^{-n}$, $S_n \asymp \sigma^{-n}\, n^{-\frac{3}{2}}$, etc. He has also determined the same numbers for substituted paraffins, etc.

K. V. I.

Studies in the Synthesis of Flavonols : The Oxidation of Flavindogenides.—Algar and Carey in the course of their experiments on the synthesis of flavonols (*Proc. Roy. Irish Acad.*, 1937, **44**, B4, 37–43), have described the oxidation of a few 3-arylidene flavanones by potassium permanganate, when 3-hydroxy-3-benzoyl-flavonones were obtained. The oxidation products on gentle hydrolysis with alkali gave the corresponding flavanol and the acid RCOOH and on treatment with cold acetic anhydride and sulphuric acid, a monoacetate. The product obtained on boiling with acetic anhydride and sodium acetate had the same molecular formula as the starting hydroxy flavanone but its exact nature is still somewhat doubtful. The oxidation products showed no colouration with alcoholic ferric chloride but dissolved in concentrated sulphuric acid, a green or voilet fluorescence developed on standing. The products obtained by applying the above reactions to 3-benzylidene-flavanone, 3-anisylidene flavanone, 3-piperonylidene flavanone and 3-benzylidene-3′, 4′-methylenedioxy flavanone have been described.

Synthetic Cyperones and Their Comparison with α- and β- Cyperones.—α- and β-cyperones occurring in the oil of the tubers of *Cyperus rotundus* have been synthesised by two different methods (P. S. Adamson, F. C. McQuillin, Robert Robinson and J. L. Simonsen, *J.C.S.*, 1937, 1576–1581) and the synthetic products have been found to be structurally identical with natural compounds, thus establishing the correctness of the constitution assigned to the cyperones. The application of the elegant cyclic ketone synthesis of du Feu, McQuillin and Robinson by condensation of *l*-diethylaminopentan-3-one and the sodio-derivative of *l*-dihydrocarvone and subsequent dehydradion with sodium ethoxide gives α-cyperone, and dehydration by cold 50 per cent. sulphuric acid gives β-cyperone. The synthetic α-cyperone had lower optical activity than the natural ketone, the density, refractive index and boiling point being almost the same. The semicarbazone of the racemised synthetic α-cyperone was crystallographically different from that of natural α-cyperone, though polymorphism was not excluded. In the alternative method, the sodio-derivative of *l*-dihydrocarvone is condensed with ethyl-β-chloropropionate and then with ethyl oxalate in alcoholic solution, ethyl-3-carbethoxy-1-methyl-4-isopropylcyclohexan-2-one-1-β-propionate being obtained after removal of CO_2. The keto-acid obtained on hydrolysis was esterified and then condensed with zinc and ethyl-α-bromopropionate. On hydrolysis of the main product, a ketone closely resembling β-cyperone was obtained. The semicarbazones of the synthetic β-cyperone by the two methods had identical m.p. and the rotatory power was not very different. The cyperones get readily racemised.

Production of the Latent Photographic Image by Hydrogen Peroxide.—Besides radioactivity, phosphorescence and heat, traces of hydrogen peroxide are found to produce latent images on the photographic emulsions. The effect of increasing concentration of hydrogen peroxide has been found to be similar to that of increasing light intensity. The reaction is initially of the second order, the decrease of the apparent order of the net reaction with increasing density being probably due to a reverse reaction, causing developable grains to become undevelopable. An optimum concentration for the production of the maximum density of the latent photographic image by hydrogen peroxide in aqueous solution is indicated (Merton W. Jones and Julian M. Blair, *Journal of Chemical Physics*, 1937, **5**, 835).

K. S. Rao.

Glaciers and Glacial Lakes of the Wicklow Hills.—In a paper on " A map of the glacier lakes and the local glaciers of the Wicklow Hills " Charlesworth (*Proc. Roy. Irish Acad.*, Section B, **44**, No. 3) records further investigations of the glacial events in the Wicklow region during the later stages of the glacial period. After describing the local glaciers, the author gives a detailed account of the glacier lakes on the eastern and western sides, and illustrates his observations with a map. It is hoped in this way to help to visualise the further problems that may remain to be solved, in particular the consequences which may be expected to flow from the relationship of the products of the

local glaciers to the lacustrine sediments of the glacier lakes.

The Meiotic Divisions in the Spermatogenesis of *Ichthyophis glutinosus*.—The maturation divisions in the testis of *Ichthyophis* are described by B. R. Seshachar (*Zeitsch. f. Zell.*, 1937, **27**, Part 2). The primary spermatocytes which are the products of division of the spermatogonia embark on the prophase of the first division after a brief period of rest. The leptotene filaments are formed soon after and the polar orientation of the filaments results in a leptotene bouquet. Parallel conjugation of the leptotene filaments gives rise to the thicker pachytene threads, the conjugation beginning at the proximal pole. When the fusion between the apposing filaments is more or less intimate the polarisation is lost and immediately after, splits appear along the threads at intervals, giving rise to the diplotene stage. The diplotene is followed by a pronounced and conspicuous diffuse stage where all individuality of the chromosomes is temporarily lost, the nucleus itself becoming a faintly staining reticulum, in its greatest developments. Soon, the chromosomes emerge from the diffuse mass and the bivalents which now appear more or less clear, twist about each other giving rise to the strepsinema. A condensation and contraction of the chromosomes give rise to the diakinesis where 21 deeply staining tetrads of different forms are seen arranged peripherally inside the nuclear membrane. The spindle is formed between the centrioles, the nuclear membrane is lost and the tetrads take their place on the spindle. 21 tetrads can be clearly seen in the metaphase plates of the division, the four components of each tetrad being seen clearly for the first time in anaphase. A conspicuous interkinesis separates the first and second divisions, when the nucleus resumes the appearance of a faintly staining network. The second division follows quickly separating each dyad into two monads. 21 dyads are seen in the metaphase plates of this division, while 21 monads can be counted in the anaphase plate. The resulting cells are the spermatids.

Chromosomes of Pyrgomorphinae.—An examination of the chromosomes of eight genera of Pyrgomorphinæ has been made by T. Ramachandra Rao (*Journ. Morph.*, September 1937, **16**, No. 2). In the spermatogonia of all the genera studied, there are 19 rod-shaped telomitic chromosomes which differ considerably regarding their actual sizes in the different genera. However, an analysis of the measurement of second spermatocyte chromosomes shows that as regards proportional sizes and inseration there is some degree of uniformity within the subfamily. In *Aularches*, *Atractomorpha*, *Chrotogonus*, *Colemania* and *Pyrgomorpha*, the members of the smallest pair of autosomes appear as roundish or oval bodies and are comparable in shape, relative size and behaviour with the 'small' dot-like chromosomes of the general Acrididæ, while in Orthacris and Zarytes they are not so and merge into the general series. The sex chromosome is the largest one in the complexes, or the second largest as in Pœcilocerus. The usual forms of tetrads occur in the spermatocytes. It is found that the number of ring tetrads in any genus depends upon the length of the chromosomes; in genera with longer chromosomes there are more of them than in genera with shorter ones. While no final explanation has been offered regarding the chromosome relationship between this subfamily and the other Acrididæ, some points arising out of the present study have been briefly discussed, and it is shown that a simple process of elimination of two pairs is not sufficient to explain the smaller chromosome number in Pyrgomorphinæ.

The Occurrence of V-shaped Centrioles in the Spermatocytes of some Neuropteran Insects.—Among the insects several species of Lepidoptera, Hymenoptera and Orthoptera have been reported upon with regard to the structure and behaviour of their centrioles. And the work previously done has been summarized by Johnson (*Zeit. Wiss. Zool.*, 1931, **140**, 116–62); and recently by Risley (*Zeit. Wiss. Zool.*, 1936, **148**, 133–58). But the group, Neuroptera, had remained unknown in this direction.

In a recent paper with the above-mentioned title (*Annota. Zool. Japan*, September 30, 1937, **16**, No. 3), J. J. Asana and S. Makino record their observations on a comparative study of the Centrioles in the species representing the Neuropteran genera, *Palpares*, *Macronemurus*, *Myrmeleon*, *Myrmecælurus* and *Neuroleon*.

The two V-shaped centrioles, with their widely diverging, thin rod-like arms, come to lie at the opposite poles as the metaphase spindle of the primary spermatocyte is formed. The concavity of the V-shaped centrioles is sometimes directed towards the equatorial plate of the spindle and sometimes away from it. In the telophase of the primary spermatocyte division, the two arms of each of the two V-shaped centrioles break apart, and as two slender, rod-like bodies they enter into interkinesis.

These centrioles of the Neuropteran species materially differ in shape and length of their arms from those of Lepidoptera. They also differ, though not so widely, from those of Orthoptera. But curiously enough Neuroptera show greater resemblance in the shape of their centrioles to Chelonia, recently investigated by Risley (1936) in his paper above cited.

A Trichomonas from the Blood of a Hamster.—Trichomonads from Mammalian blood are rare and W. L. Yakimoff and A. I. Sprinholz-Schmidt (*Journ. Roy. Micros. Soc.*, September 1937, **57**, Part 3), report the occurrence of a Tritrichomonas from the blood of *Cricetulus furunculus*. A broad spindle-shaped body, a central axostyle protruding posteriorly as a spine, an anterior elongated nucleus, and three anterior and one posterior flagella characterise the animal. A few metachromatic granules were also found in the cytoplasm. Though the examination of the blood was done after the death of the host, there is every reason to believe that they are normally parasites in the blood of the host and their presence in blood is not due to secondary invasion from the alimentary canal.

Annual Convention of the Sugar Technologists.

THE Sixth Annual Convention of the Sugar Technologists Association of India was held in the Ceremonial Hall of the Imperial Institute of Sugar Technology, Agricultural Gardens, Cawnpore, on the 24th and 25th October 1937. A large number of members and distinguished visitors, both officials and non-officials, were present. Sardar Kirpal Singh Majithia, President of the Association, was in the chair.

The President in his address referred to the rapid development of the industry during the past few years and sounded a note of warning against over-production, and consequent fall of sugar prices.

Reviewing briefly the problems that should be tackled by the technologists, the President laid stress first on the agricultural problems and mentioned a few important points on which reliable and authentic data should be collected. Coming to the engineering problems, the question of fuel economy should engage the attention of engineers and in solving this there should be willing co-operation between the manufacturing and engineering staff. Amongst the problems that should be tackled on the manufacturing side, mention should be made of the minimising of losses in the factory, improvement of the quality of sugar and utilisation of the bye-products.

The Business Meeting of the Association held in the afternoon of the 25th October, Mr. R. C. Srivastava, the Honorary Secretary, reviewed the present position of the sugar industry and stated that there was an increase of 21 per cent. in the production of sugar as against that of the previous year. The prospects of the coming season are uncertain. The two factors contributing to the uncertainty are, firstly, the scale of sugarcane prices to be enforced during the next season, and secondly, the absence of a strong organization for controlling sugar sales.

Forty-four technical papers covering all the aspects of the industry, *viz.*, agriculture, engineering, manufacture and bye-products were presented and discussed.

DR. B. K. MUKERJI gave a summary of the results of pot culture and field experiments carried out under his supervision on "molasses as fertilizer". His deductions are:—(*a*) In actual practice, nitrogen fixation by molasses in a normal soil is scarcely realised. There is considerable room for doubting the indirect beneficial effect of molasses on the fertility of U.P soils. (*b*) In U.P. potash does not add anything appreciably to the yield of crops like wheat, maize and potato. (*c*) There are *a priori* reasons to believe that for the reclamation of *usar* land application of about 10 tons of molasses per acre would give satisfactory results, particularly with the paddy crop.

J. S. CHALUPA (Skoda Works, Prague) had an interesting paper on "Massecuite crystallizers with cooling equipment". It is unfortunate that these rapid crystallizers are sneered at by sugar technologists in India; on the other hand, the makers assert that the technologists are too indolent to learn the basic principles for their proper working.

R. C. SRIVASTAVA'S "Efficiency of production of sugar in India" and L. H. HATTWAITE'S "Description and comparative study of various types of modern furnaces for burning bagasse for steam boilers," gave useful summaries of the respective aspects of the sugar industry.

On the agricultural side of sugarcane, a number of papers were contributed from the Shahjehanpur and the Lyallpur Experimental Farms, materially increasing our knowledge of the subject.

A. N. KAPUR'S study of "Evaporator scales in Bombay, "Deccan sugar factories" and J. P. SHUKLA'S on "Butyl fermentation" are hopeful signs for the research capability of our young sugar chemists.

Other papers which attracted special notice were:—DR. SUKHATME: "On the problem of specifying standards for grain of sugar", giving a clear and concise exposition of the principles of statistical science when applied to the problem. It seems to be the first one of its kind on the subject.

DR. CHATTERJI: "Refining of gur with solvents" is a bold attempt to set up a wholly different and novel technique in sugar technology, namely, to leach out the colouring matter and the greater part of the reducing sugars by means of methyl alcohol. It transpired that a small laboratory pilot plant is shortly to be rigged up to try the process further.

A paper on "A rapid process for making fertilizers from molasses" contributed by Dr. Sen and others, was certainly the most remarkable for more reasons than one. It claims to establish that in the process described (a combination of bacterial bed percolation activated sludge and lime processes for sewage treatment) atmospheric nitrogen is abstracted from air and gets fixed!

On the whole, this annual Conference served an extremely useful purpose, in consolidating the scientific and technical work done during the year in the Indian Sugar Industry.

Are the Himalayas Compensated?*

By D. N. Wadia.

THE rise of the Himalayas from the floor of the ancient *Mediterranean* sea, a Sea which stretched across the earth from the Central Europe to Western China, is an epic of the geological history of Asia. All the relevant facts of this event are well dated and documented in the rock-records of these mountains laid bare in the valleys and defiles. Paradoxical as it may seem, mountains denote the weaker belts of the earth's surface, belts that have been depressed below the sea for long ages and have received enormously thick deposits of marine sediments belonging to long cycles of geological ages. It is these overloaded and consequently weakened zones of the earth's circumference which respond most to the lateral and tangential earth-pressures which follow the cessation of the sinking process and become folded and elevated into mountain-chains during periods of great compression. Hence has arisen the well-known principle of geology that where areas of the earth have sunk deepest, they also rise highest. These sunken and loaded belts are called *geosynclines* in geology. During the process of compression (by tangential forces) of these sunken and loaded zones into mountains, they are narrowed to almost a quarter of their original width. The Himalaya system of mountains represents the largest individual geosyncline on the face of the earth, containing over 30,000 of sediments—strata representative of all geological ages from the Carboniferous to the Eocene. Their uplift from the mediterranean sea-bed was not a single act, but there were three distinct and widely separated phases of elevation. The earliest was in the beginning of the Tertiary era of geological history, while the latest was in Sub-recent times, a date which, measured in terms of geological antiquity, is almost as recent as yesterday. There are evidences that all earth-movement has not entirely disappeared, for something like 5,000–8,000 feet of uplift has taken place in the Western Himalaya since Man appeared on earth.

With regard to the static relations of the Himalayas and their physical adjustment with the interior of the earth, it may be mentioned that geodesy does not regard mountains as mere unadjusted excrescences on the surface of the earth. If Central Asia, with the high-standing Tibetian plateau supporting the Himalayan chain, were extra masses of rock piled on the circumference of a homogeneous earth uniform to the core, the waters of the Indian Ocean would be pulled up a considerable distance towards the Himalayas, extending much beyond the present heads of the Arabian Sea and the Bay of Bengal. The fact that the sea-level is not appreciably affected shows that the continents and mountainous portions of the earth's body, in relation to the hollows of the great oceans, are in some sort of adjustment with their bases and are commonly believed to be supported on a dense semi-plastic substratum by a process of flotation, somewhat as ice-caps are supported on the surface of the polar seas. This theory of support of mountains by flotation on a dense medium gives a rational explanation of the existence of what is commonly termed "mountain compensation", and also accounts for the stability of some abnormally abrupt geographical features, *e.g.*, the great Andian chain rising 20,000 feet in altitude above the sea-level, right in front of a sub-marine depression which plunges down 26,000 feet below that level.

That the earth is not homogeneous and uniformly rigid to the core is borne out by the phenomena of earthquakes, vulcanicity, tides, etc. To small periodic forces, *e.g.*, earthquake waves, the average rigidity of the earth's crust as a whole is twice that of steel. But to prolonged extensive pressures, such as those exerted at the root of the Himalayas or by continental ice-sheets, such as that of Greenland (a mass of over a million square miles having a thickness of 3,000 feet), the earth behaves as a plastic body and the surface sinks under the load, rising again when a diminution of the load takes place.

Below the cold rigid crust the earth seems to have but little strength, to judge from these proofs of its mobility. Early in his work (1830), Everest recognized that the Himalayas would exercise a disturbing effect by their gravitative attraction in the triangulation of India, which necessitated the accurate measurement of the arc of the meridian from Cape Comorin to the foot of the Himalaya near Mussoorie.

Plumb-line and pendulum observations at Dehra Dun have shown that "topographical deflection", *i.e.*, deflection from the normal, due to the gravitative pull exerted by the calculated visible mass of the Himalayas, is 86 feet, but the true observed deflection of a plumb-line is only 31″. For Murree, in the Kashmir Sub-Himalaya, the figures are 45″ and 12″ respectively, while at Katiana, which is only 50 miles south of the foot of the Himalaya, the observed deflection is only 1″, whereas it ought to be 58″. These observations suggest that the excess rock material lying above the main surface of the earth, constituting the Himalayas, is compensated for by a defect of density in the rock layers underlying the mountains. In other words, this theory (Isostasy) postulates that there is an adjustment between surface geographical features and an arrangement of density in the earth's interior, so that above each region of less density in the sub-crust there will be a surface bulge, while over tracts of greater subterranean density there will be hollows or depressions—the former will be the continents, plateaus and mountains; the latter will be basins of the oceans and seas. This hypothesis, which first originated in India as a highly suggestive speculation of Archdeacon Prat, has had a great vogue in America.

* Condensed summary of a lecture delivered at the Allahabad University on the occasion of the celebration of its Golden Jubilee, on 14th December 1937.

Movements of gravity and deviations from the vertical, as carried out by the Geodetic Survey of India during the last two decades, give some support to the main facts of Isostasy by indicating that the principal relief features of India are in a large measure compensated, though many discrepancies still remain to be explained.

To what extent are the Himalayas compensated? Observations at a number of stations in the midst of the Himalayas enable us to say that there is a defect of compensation in the outer foot-hills, known as the Sub-Himalayan zone; in other words, this area is undercompensated and one of surface overload. This defect increases in amount until, according to Oldham, " at some 50 miles from the edge of the hills it reaches an equivalent to an overload of about 2,000 feet of rock ". In the interior of the Himalayas in the central ranges there is, on the other hand, over-compensation, that is, mountain material is in defect, due perhaps to excessive erosion by rain and rivers, while the underground density at the root of the mountains is of a high order.

If these facts ultimately prove to be well-established, the question of the origin of mountain ranges would appear to be largely dependent on the provision of an underground belt of rocks of excessive specific gravity. The primary factor in mountain-building would thus be not the formation of a deep geosynclinal trough with its pile of sediments, but the changes in underground mechanics bringing about movements in the denser basaltic layers under the sub-crust.

It appears from a consideration of isostatic facts and the data from gravity investigations that, on the whole, India is an area of defective density of mass. Gravity in India is in deficit in spite of all the height, bulk and weight the Himalayas have given to it, and it needs a thick stratum of rock, somewhere about 600 feet thick, spread over the entire surface of the country to counterbalance this deficit of mass.

The Sex Ratio.*

"THE subject of the numerical proportions of the sexes in a population is of such obvious interest to the naturalist, the sociologist, the economist amongst others, that it is not surprising to find that to it considerable attention has been paid, but so complicated are the problems that cluster round it that even yet our understanding of the significance of the sex ratio is still very incomplete." Darwin (1871) wrote: " I formerly thought that when a tendency to produce the two sexes in equal numbers was an advantage to the species it would follow from natural selection, but I now see that the whole problem is so intricate that it is safer to leave its solution for the future." Prof. Crew, in view of the recent developments in cyto-genetics, which have removed many of the difficulties that surrounded the subject in Darwin's time, has re-examined the problem in great detail. In the case of the human beings, after analysing the figures available, he finds that " to be born is a more dangerous adventure for the male than for the female, and that there is a sexually selective mortality which not only operates at all ages after birth to the disadvantage of the male, but which acts and possibly equally strongly pre-natally as well. The expectation of life at all ages is greater in the case of the female of the species, and the true recipe for longevity is to be born a girl." After dealing with the application of the metabolic theory and the alternative sex-linked lethal theory to man he examines at some length the application of these theories to other animals, such as mammals, birds and insects, and concludes that " It is thus possible to look upon the inequality in capacity for continued life between the sexes as being partly of the nature of an evolutionary oversight due to a lag in the development of a harmonious relationship between the mechanisms of mutation and heterogamety. But this disharmony has been repaired by the invention of a supplementary device which can provide a compensatory primary sex ratio, high in those species with male heterogamety, low in those in which the heterogametic sex is the female."

In his Address, Prof. Crew has presented evidence to show that three possible causes of sex differences in mortality have to be considered: (1) " sex-linked lethals, (2) sex limitation of defects and derangements, and (3) sex-dimorphic physiological and endocrinological differences." He is of the opinion that probably " sex-linked lethals play only a minor part and that the defects and derangements that have come to be manifested only or more completely in the male owing to his relative unimportance in respect of propagation, constitute the major cause ". In the Address he tries to reconcile the views of the geneticists and of the physiologists and is of the opinion that the problem of the human sex ratio must be studied not only by the statisticians but also by the experimental biologists both in the laboratory and in the open country.

* Summary of the Presidential Address of Prof. F. A. E. Crew, D.Sc. Zoology Section, British Association for the Advancement of Science, Nottingham, 1937.

SCIENCE NOTES.

Prof. Albert van Szent Györgyi has been declared winner of the 1937 Nobel Prize for Physiology and Medicine. He was elected to receive the prize " as a reward for his discoveries on the biological processes of combustion, specially in relation to Vitamins A and C ". For the history of the discovery of Vitamin C, readers of *Current Science* are referred to a contribution by the Nobel Laureate himself, in this Journal (*Curr. Sci.*, 1936, **5**, 285).

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We regret to have to report the death of **Prof. Hans Molisch,** distinguished Botanist at the age of 81. The following account of the life and work of Prof. Molisch has been taken from *Plant Physiology*, July 1937, No. 3:

Hans Molisch was born at Brunn (Mahren) on July 12, 1856. His parents were Johann and Franziska (Matza) Molisch. He was educated at the K.K. Deutschen Ober-Gymnasium at Brunn and at the University of Vienna, which institution he entered in 1885. On March 10, 1888, he was married to Ida Knoller, who is the mother of two children, Paul, born in 1889 and Fritz, born in 1894.

In 1889 Hans Molisch became ausserordentlicher Professor at the Technische Hochschule in Graz. Several years later, he moved to Prag, where in 1894, he was appointed Ordentlicher Offentlicher Professor in the German University and Director of the Plant Physiological Institute. In 1909 he returned to Vienna with the same title. During 1922 to 1925 he was Visiting Professor at the Imperial University at Sendai, Japan, and travelled extensively in the Orient. Since 1925 he has been at the University of Vienna an Emeritus Professor of Plant Physiology. Throughout these years of his professional life he was very active in his investigations, and has published over 200 papers on plant physiology. He is also well known for his many books (about 20), some of which are standard text-books used in the universities while others serve to increase popular interest in physiological experiments. He was elected a corresponding member of the *American Society of Plant Physiologists* at St. Louis in 1935.

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Gandhara School of Sculpture.—The Archæological Survey of India has recently published a *Guide* to the sculpture of the Indian Museum, Part II, which gives an account of the genesis of the Gandhara School of Sculputre. The Greeco-Buddhist School of Sculputre originated about the second century B.C. on the North-Western Frontier of India, the ancient Gandhara Country and remained at the service of the Buddhist Church for at least five centuries before it disappeared with the coming of the devastating hordes of the white Huns who swept over the Indian plains. The Gandhara region was the meeting ground of three civilizations—Indian, Greek and Persian, and the resulting hybrid culture found expression in a School of Art that employed a technique borrowed from the Greek and Roman masters, but modified according to Indian requirements. The first specimen of this style in the Indian Museum is a relief representing Buddha, collected in 1833-34 by Dr. Gerard near Kabul and presented to the Asiatic Society of Bengal. Other valuable presentations to the Museum include, Sir Alexandar Cunningham's collections from Jamalgarhi and other sites in the Peshawar District in 1848 and 1876, the sculptures discovered by Major Cole in 1883 at Senghao to the north of Mardan and the large collection brought back by Caddy in 1895-96 from Loriyan Tangai in the Swat Valley.

An important feature of the *Guide* is a map showing the principal sites of the Gandhara tract.

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Archaeological Excavations in the Punjab and the U.P.—Archæological excavations have recently been started at Khokrakot, near the town of Rohtak in the Punjab, and at Kosam, which has been identified as the site of the ancient city of Kausambi, near Allahabad. There is at Khokrakot an extensive mound of ancient origin and it is hoped that the survey now started in the South-East Punjab and Western U.P. will throw some light on India's ancient history, which is particularly obscure in the period between the prehistoric Indus Culture, and the historic age commencing with the birth of Buddhism in the Lower Gangetic Basin.

Two hoards of cast copper coins which were in use in the early centuries of the Christian era have been discovered in the excavations and the place bids fair to be the richest site for antiquities in Northern India.

A new departure in these excavations is the arrangement made to associate with the work, scholars deputed from Universities. In response to the suggestion made by the Director-General of Archæology to the Universities of India, the Benares University has sent one scholar to Kausambi to work with the official explorer, and the Punjab University, another who is now associated with the work at Rohtak. One of the greatest needs in archæological work has all along been men who combine in themselves intellectual abilities of the highest order with considerable physical stamina to bear up against hardship. The steps now taken to associate young scholars, fresh from their Universities, with the strenuous work of an archæological explorer, who works in the field, it is believed, will in time remove this long-felt want.

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The Records of the Mysore Geological Department (Vol. 35), which we have just received, contains, in addition to the Director's General Report for the year 1935-36, a few papers dealing with some of the deposits of economic value occurring in Mysore. In the paper on the " Gold bearing Alluvium in the Tungabhadra and its tributaries in the Shimoga and Honnali Taluks "—Mr. S. Lakshmana Rao gives a brief account of the physical features and geology of the area and proceeds to describe in detail the several localities where the occurrence of alluvial gold has been noticed. The author concludes that these several deposits are of such small value that they do not justify the undertaking of any large-scale dredging operations. Mr. T. P. Krishnachar has described some occurrences of clays and kaolins in the neighbourhood of Bangalore, and shows that the former are well suited for the manufacture of stoneware pipes, etc., and the latter for making porcelain. Mr. M.R. Ananthanarayana Iyer has an interesting

paper on a graphical representation of the composition of some manganese minerals, including a discussion of the nature of the mineral Vredenburgite.

Technological Reports on Standard Indian Cottons.—The Director of the Technological Laboratory, Indian Central Cotton Committee, has recently brought out a Bulletin dealing with the various improved strains of cotton grown regularly and on a large scale in the different provinces of India. It embodies the following details:—Season in which it is grown, Botanical Classification, History, Grader's Report, Fibre Properties, Spinning Tests, Yarn Tests, etc. The publication will be found useful to the producer, breeder and spinning and weaving mills, inland and abroad, who are concerned with standard Indian cottons. Copies of the Bulletin can be had of the Secretary, Indian Central Cotton Committee, Bombay, at Rs. 1–8–0 *plus* postage.

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Microbiology in the Preservation of Animal Tissues.—The successful storage of animal tissues is, in the first instance, an exercise in applied microbiology. It is thought, therefore, that a useful purpose may be served by an attempt to gather together an account of some of the more fundamental bacteriological aspects of the problem.

In the first part of a Report issued by H. M. Stationery Office (Food Investigation; Special Report No. 45), consideration is given to the effect of *ante-mortem* factors; in the second, an outline of the physiology and biochemistry of certain micro-organisms is sketched, and in the final section, an attempt is made to indicate the lines along which control of infection and growth may best be carried out.

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Official Publications on Motoring Subjects. H. M. Stationery Office has placed on sale a number of official publications dealing with various aspects of road traffic matters. Recent reports include the following:—(1) The use of coloured light for Motor Car Headlights, (2) Regulations on construction and design, etc., (3) Road Traffic, (4) Noise, (5) Road Surfaces, (6) Experimental Work on Roads and (7) Road safety among School Children.

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The Science Press of India.—A Science news service, under the name of the *Science Press of India* has been started to serve the daily and weekly press of India with (1) Important science news from all parts of the world; (2) Views of leading scientists of India on matters of scientific industrial, agricultural and medical importance; (3) Short popular articles dealing with every-day science and with the work of Indian scientists; and (4) Reviews of important works on science of interest to the general public. It will be run on the lines of similar organisations that are functioning in England, Germany and America.

Further details regarding the Science Press of India can be had from Dr. B. L. Bhatia, D.Sc., F.Z.S., F.R.M.S., F.A.Sc., F.N.I., K.H.M., Director, Science Press of India, Hotusingh Road, Lahore.

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Zoological Expedition to Burma.—A party of twenty students of the Banares Hindu University under the leadership of Dr. A. B. Misra, Professor of Zoology, went to Burma in October 1937, to study the zoo-ecology of animal life in certain selected parts of that country. The party visited Rangoon, Toungoo, Pathichaung, Thandaung, Mandalay, Madaiya, Moulmein, Bilugyun island, Paung and Zingayik. Some of these places which were selected especially for the purpose of ecological work, proved to be excellent localities for field-work. Part of the expenses of this expedition was defrayed by the Benares Hindu University, and the remainder met out of funds raised from private sources. This adventure had been approved of by the Vice-Chancellor, Pandit M. Malaviya. At the request of Dr. Misra, Mr. Ramnivas Bagla of Moulmein has presented a Gold Medal to be awarded to the best field-worker among the students, and this has been won by Mr. Narayan Chandra of the B.Sc. (final) Class.

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Sir Martin Forster, F.R.S., delivered the twentieth Streatfield Memorial Lecture on the 15th October. Sir Robert H. Pickard, F.R.S., who presided, in introducing the lecturer, said that Sir Martin was one of the most distinguished and successful of those who had been pupils of Frederick William Streatfield at Finsbury Technical College. The subject of the address was "Chemical Changes and Chances", the merits of which can be best appreciated by reading through the entire text which has been published by the Institute of Chemistry. At the conclusion of the address, the President handed Sir Martin Forster, the Medal presented by the City and Guilds of London Institute together with a photograph of Streatfield.

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Sir S. Radhakrishnan.—The term of the appointment of Professor S. Radhakrishnan, Spalding Professor of Eastern Religions and Ethics, Oxford, has been extended to a period of 15 years. This has been done at the instance of the three faculties of Theology, Philosophy and Oriental Studies of the University. The arrangement also permits Sir S. Radhakrishnan to spend six months in the year at the Calcutta University.

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Sir James Jeans, President Elect of the forthcoming Indian Science Congress, Calcutta, and Dr. F. W. Aston, F.R.S., have been awarded the **Joy Kisen Mukerji Gold Medals** for the year 1937, and 1938 respectively by the Indian Association for the Cultivation of Science. SirJohn Russell, F.R.S., was the first recipient of this medal.

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The United Provinces Pharmaceutical Association.—The General Annual Meeting of the U.P. Pharmaceutical Association was held in the Department of Pharmaceutics, Banares Hindu University, on the 19th November 1937. After the acceptance of the annual report and audited statement of accounts, the Office-bearers of the Council of the Association for the year 1938 were elected. Rai Bahadur Dr. B. N. Vyas, Lucknow, was elected President and Capt. S. K. Choudhury, Chief Medical Officer, Benares State, was elected Vice-President. Prof. M. L. Schroff, Head of the Department of Pharmaceutics, Benares Hindu University, was elected Hon. Secretary.

The U.P. Pharmaceutical Association has been recently registered under the Societies Registration

Act of 1860 and has the following aims and objects. (*a*) To train men for the profession of Pharmacy in the United Provinces who will be *at par* with those in other civilised countries and to devise ways and means for the attainment of this ideal. (*b*) To promote the cause of the science and art of Pharmacy in all their different branches. (*c*) To raise the status, outlook and ethics of those who are directly or indirectly engaged in pharmaceutical trade and profession by absorbing in the Association the various allied associations of the Province. (*d*) To participate in matters of interest affecting the science, art or profession of Pharmacy by sending representatives or otherwise, to various bodies dealing with or interested in such matters. (*e*) To hold examinations under the Association and to grant degrees and diplomas to properly qualified persons. (*f*) To establish a laboratory for the investigation of indigenous drugs with a view to incorporate the useful ones in an Indian Pharmacopœia when it is published. (*g*) To edit and publish journals, books, magazines, documents and other publications for promoting the cause of Pharmacy in India.

The ordinary membership of the Association will be open to those persons who hold the following qualifications: (*a*) Persons who are graduates in Pharmacy or Pharmaceutical Chemistry, of any University or College recognised by the Association. (*b*) Persons who are registered practitioners of medicine or surgery. (*c*) Persons who have worked for at least five years in some dispensary or hospital subsequent to the passing of an examination for the certificate of a compounder or dispensing chemist. (*e*) Persons who have passed any other examination requiring at least two years' training in Pharmacy and Pharmaceutical Chemistry subsequent to the Matriculation Examination or an equivalent examination held by any University or Board or High School and Intermediate Examination of the United Provinces. (*e*) Persons who have passed any of the examinations of this Association. (*f*) Persons who have been engaged in any manufacturing Pharmaceutical Laboratory for at least five years subsequent to their graduation from a University. (*g*) Persons who have been engaged in teaching pharmaceutical subjects, including Chemistry.

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Indian Chemical Society.—At the ordinary meeting of the Society held on November 19th, the following gentlemen were admitted as Fellows:—(1) Sailesh Chandra Sen, M.Sc. (*Pusa*); (2) Sardar Doghar Singh (*Travancore*); (3) Dr. A. N. Ghei, M.B., B.S., D.T.M., D.P.H. (*Lahore*); (4) Mr. M. Raman Nayar, M.A., A.I.I.Sc. (*Lucknow*); (5) B. N. Pramanik, M.Sc., Ph.D. (*Shahjahanpur*); (6) N. K. Brahmachari, B.Sc. (*Calcutta*).

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National Institute of Sciences of India.—The Seventh Ordinary General Meeting of the National Institute of Sciences of India was held at Delhi, on Saturday, the 6th November, Prof. M. N. Saha presiding.

1. Condolence resolutions touching the death of Prof. Albert Heim and Lord Rutherford of Nelson were passed.

2. The following gentlemen were elected Ordinary Fellows:—Prof. Y. Bhâradwâja, Principal B. L. Bhatia, Prof. G. R. Paranjpe, Dr. H. Srinivasa Rao, Dr. K. Rangadhama Rao, Prof. M. R. Siddiqui, Prof. A. C. Sirkar, Dr. M. B. Soparkar, Hon'ble Sir Shah M. Sulaiman and Col. F. C. Temple.

3. The following gentlemen were elected Honorary Fellows:—Prof. Ludwig Diels, Sir James G. Frazer, Prof. Robert Robinson and Dr. C. M. Wenyon.

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Royal Asiatic Society of Bengal.—At the Ordinary Meeting held on Monday, 6th December, Charu Chandra Das-Gupta read an interesting paper entitled *Bibliography of Ancient Indian Terracotta Figurines*. The paper constitutes the first attempt to give a complete bibliography of ancient Indian terracotta figurines.

At the same meeting, Mr. Chintaharan Chakravarti exhibited manuscripts of a Tantra Work giving *inter alia* the family history of the royal patron of the author. Two communications: (1) "Possibilities of the Persian quatrain", by L. S. Dugin and (2) "The Study of Heraclitus", by John van Manen, were made at the same meeting.

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Allahabad University.—At the Special Convocation held in connection with the Golden Jubilee Celebrations of the Allahabad University presided over by H. E. Sir Harry Haig, the Chancellor, Honorary Doctorates were conferred on the following eminent Scientists:—

D.Sc.—Sir Shah Sulaiman, Sir P. C. Ray, Sir Arthur Eddington and Dr. V. H. Blackman.

Merit Doctorates were conferred on Mr. Surendralal Das, Mr. Muralidhar Srivastava, Mr. G. D. Bhale Rao, Mr. Radheraman Agarwal, Mr. S. K. Banerji, Mr. S. K. Mukherji, Mr. Santaprasad Tandon, Mr. L. S. Mathur and Mr. V. N. Chatterji.

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Andhra University.—Dr. C. R. Reddy, Vice-Chancellor, Andhra University, announced, on the occasion of the annual convocation, held on the 2nd December, that H. H. The Maharaja of Travancore and Maharani Sethu Parvathi Bai have donated a lakh of Rupees for the University. He also announced that a sum of Rs. one lakh has been most graciously donated by H. E. H. The Nizam of Hyderabad.

The Honorary Degree of Doctor of Literature was conferred on H. H. The Maharaja of Travancore and on Her Highness the Maharani Sethu Parvathi Bai in recognition of their "great and courageous act of social liberation and national significance effected by throwing open the temples in their traditionally orthodox State to the entry of Harijans."

The Raja Sahib of Challapalli has been pleased to donate Rs. 8,000 to found a senior Studentship in the University. The Maharaja of Jeypore and Sir Alladi Krishnaswami Aiyar have donated Rs. 3,000 each for the creation of two Studentships.

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Benares Hindu University.—At the Twenty-First Annual General Meeting of the Court of the Benares Hindu University, held on the 27th November, Pandit Madan Mohan Malaviya, Vice-Chancellor, announced that H. H. The Maharaja Sahib of Bikaner had been pleased to

donate a sum of Rs. 25,000 on the occasion of the Golden Jubilee Celebration of his accession to the throne.

Seth Mathurdas Vasanji donated a sum of Rs. one lakh which is in the form of an endowment, the interest of which will be utilized for the purposes of the University. The Vice-Chancellor also announced that H. H. The Maharaja of Panna has promised a donation of Rs. 1 lakh and H. H. The Maharaja Sahib of Dewas (Junior) Rs. 20,000.

In pursuance of its policy to encourage the advancement of technical and professional education, the Senate has introduced courses of instruction in glass technology. The regulations provide for two degree examinations, B.Sc., and M.Sc., in Glass Technology and a Certificate Examination. The U.P. Government has sanctioned a grant of Rs. 8,000 to the Department of Research.

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University of Mysore.—1. *Personnel*: (1) Mr. A. B. Mackintosh, M.A., on his return from leave took charge of the Principalship of the Central College, Bangalore, on the forenoon of the 15th November 1937, from Mr. C. R. Narayan Rao, M.A., L.T., Professor of Zoology and Officiating Principal, permitted to retire from that date.

(2) Dr. A. Subba Rau, B.A., D.Sc. (Lond.), Professor of Physiology, Medical College, Mysore, appointed as Professor of Zoology, Central College, *vice* Mr. C. R. Narayan Rao, took charge of his new office on the forenoon of the 22nd November 1937.

(3) Mr. S. Hiriyannaiya, B.A., M.B.B.S., Assistant Professor of Physiology, Medical College, Mysore, was appointed to act as Professor of Physiology in the College, *vice* Dr. A. Subba Rau transferred to the Central College.

(4) Consequent on the grant of three months' leave to Dr. P. R. Subba Rao, Professor of Ophthalmology, Medical College, Mr. A. M. Ponnambalam, Professor of Pharmacology, was appointed as Professor of Ophthalmology.

2. *Lectures.*—Mr. Ernest Salter Davies, C.B.E., M.A. (Oxon.), Director of Education, Kent, England, delivered a lecture at Bangalore on "Education for Industry and for Life".

3. *Meeting of the Senate.*—The ordinary meeting of the Senate for the year was held on the 27th November 1937.

Among the propositions that were passed, mention may be made of the following:—

(i) Prescription of the minimum percentage of marks to be obtained by candidates for the S.S.L.C. Examination under the revised scheme for being eligible for admission to University courses of study.

(ii) Course of studies and scheme of examination in Hindi as an optional subject for the Intermediate Examination in Arts.

(iii) Addition of the following to the list of optional groups for the B.Sc. degree examination:—

Physics, Mathematics, Economics.
Chemistry, Geology, Botany.
Chemistry, Geology, Zoology.

(iv) Provision for candidates failing in the Honours Degree examination to take the ordinary degree examination.

(v) Limiting the number of attempts at the Pre-Medical Examination to two instead of three.

(vi) The following proposals were recommended to the University Council for consideration:—

(*a*) Institution of a course for diploma in Music controlled and recognised by the University. (*b*) Institution of a course in Insurance Business as one of the branches of study in the University. (*c*) Reduction of the scale of tuition fees in all the colleges to the old scale. (*d*) Institution of a system of voluntary service by the graduates of the University.

The Senate resolved to record its sense of gratitude to *Rajasabhabhushana Diwan Bahadur* Dr. Sir K. P. Puttanna Chetty, Kt., C.I.E., LL.D., for his generous donation to the University.

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Nagpur University.—The University Court has accepted the recommendation of the Academic Council to confer the degree of LL.D. on Mahatma Gandhi. The Court has also decided to confer the same degree on H. E. Sir Hyde Gowan.

Mr. T. J. Kedar was elected Vice-Chancellor of the University, at the meeting of the Court, held on the 10th December.

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Travancore University.—Dr. D. L. Mowdgill, D.Sc., has been appointed as the Director of research in the University to conduct researches in applied science in the Central Research Institute which aims at co-ordinating the research work carried out in the laboratories attached to various departments of the Government of Travancore. Dr. H. Parameswaran, D.Sc., has been appoined Director of Technology.

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Modified Schering Bridge.—For the purpose of determining the characteristics of samples of both liquid and solid dielectrics, the Leeds & Northrup Company has developed a modified form of Schering Bridge in which convenience, safety and accuracy are considerably enhanced. High voltage is applied only to the test sample and to the standard air capacitor. All adjustable elements being confined within a grounded shield, the operator is fully protected and accuracy is assured. The guard rings of the standard capacitor and of the sample are brought to the proper potential by merely connecting them to the grounded shield.

A method of compensation for residual capacitance is used which enables results to be calculated from simple equations. In the case of low power factors, the result is read directly. Capacitances ranging from 40 mmf to 0·020 mf and power factors from 0·0091 to 0·70 can be accurately determined.

The bridge is intended for use on 60 cycle circuits and the standard air capacitor and sample holders listed are rated at 10 K. V. Apparatus for other voltages and frequencies can be supplied.

For further details, ask for Catalog E–54 (2) from Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania or their Sole Agents in India: The Scientific Instrument Co., Ltd., 5 A, Albert Road, Allahabad.

Announcements.

Chronica Botanica.—From February 1938 *Chronica Botanica* will be issued *bi-monthly* and no longer as a Year-book. The annual subscription will be reduced from 15 to 7 guilders. The new periodical will continue to give all the essential information which was given in the old year-book, and will include some important new sections as well. Like the Year-book, the new Chronica will *aim at promoting documentation, good-will and international co-operation among plant scientists.* Results of research will be published only in the first two sections. The world list of plant science institutions and societies will appear as an annual supplement. The contents of the reorganized Chronica will be as follows :—

(1) *Scientific Communications* : A medium for the quick publication of short preliminary notes on the results of recent research or announcing new discoveries. (2) *Forum Botanicorum* : Discussions, Announcements, Letters to the Editor. (3) *International Congresses* : Detailed programmes, short reports, decisions, resolutions, etc. (4) *Quotations* : From recent articles of general and timely interest. (5) *Miscelleneous News* : News notes of all kinds of plant science institutions, experiment stations, gardens, etc., including notes on new research projects. (6) *Herbarium and Museum News* : Expeditions, new collections, lists of new acquisitions, etc. (7) *Personalia* : Appointments, Retirements, Resignations, Deaths (short obituaries), Miscellaneous, New addresses. (8) *Queries* : Requests for co-operation and information, exchange offers. (9) *New Periodicals* : Short accounts of new plant science periodicals, changes in existing periodicals. (10) *New Books* : Short reviews of new plant science books.

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Indian Statistical Conference.—The Conference will be held at Calcutta from 7–9th January 1938 ; Prof. R. A. Fisher will be the General President. The work of the Conference will be carried on in active co-operation with the Indian Science Congress and two joint discussions with the Indian Science Congress, one on Agricultural Statistics and the other on Theoretical Statistics, have been organised. One or two sessions of the Conference will be devoted to Economic Statistics and one session to Public Health and Vital Statistics.

The minimum subscription for membership of the Conference will be Rs. 10.

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The Annual General Meeting of the Indian Chemical Society will be held at Calcutta in the Chemistry Section Room of the Indian Science Congress, on 5th January 1938.

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Lucknow University Studies.

The following Science Lectures have been arranged for the Winter Session (1937–38). The lectures will be held at 6-30 P.M. on the days notified :—

Jan. 12, 13 and 14 (Biology Theatre).—
" The theory of non-linear partial differential equations."
By Dr. M. R. Siddiqi, Ph.D., Professor of Mathematics, Osmania University, Hyderabad.

Jan. 29, 30 and 31 (Biology Theatre).—
"[Physiological psychology. "
By Dr. W. Burridge, Prof. of Physiology and Dean, Faculty of Medicine.

Feb. 4, 5 and 6 (Biology Theatre).—
" The mean value theorem of the differential calculus and its applications. "
By Dr. A. N. Singh, Lecturer in Mathematics.

Feb. 11, 12 and 13 (Chemistry Theatre).—
" The Nature of protective foods. "
By Dr. B. M. Gupta, Ph.D., Assistant Public Analyst, Lucknow.

Feb. 19, 20 and 21 (Chemistry Theatre).—
" The temperature co-efficient of chemical reactions." By Dr. A. C. Chatterji, Lecturer in Chemistry.

Feb. 26 and 27 (Chemistry Theatre).—
" Chemical processes in gaseous systems."
By Professor P. S. MacMahon, Head of the Chemistry Department.

March 5 and 6 (Biology Theatre).—
" The problem of plant immunity."
By Dr. S. N. Das Gupta, Reader in Botany.

March 18 and 19 (Biology Theatre).—
" The poisonous plants of India. "
By Brev.-Col. R. N. Chopra, Sc.D., I.M.S., School of Tropical Medicine, Calcutta.

March 20 (Biology Theatre).—
" The solar corona."
By Dr. M. N. Saha, D.Sc., F.R.S., Professor of Physics, Allahabad University.

We acknowledge with thanks, receipt of the following :—

" Agricultural Gazette of New South Wales," Vol. 48, No. 11.
" Allahabad Farmer," Vol. 11, No. 6.
" American Museum of Natural History," Journal Vol. 40, No. 4.
" Biochemical Journal," Vol. 31, No. 10.
" Biological Reviews," Vol. 12, No. 4.
" Berichte Der Deutschen Chemischen Gesselschaft," Vol. 70, No. 11.
" Bulletin of the American Meteorological Society," Vol. 18, No. 9.
" Bulletin of the University of Illinois," Vol. 34, No. 103.
" Calcutta Medical Journal," Vol. 32, No. 11.
" Canadian Journal of Research," Vol. 15, No. 10.
" Contributions from Boyce-Thomson Institute," Vol. 9, No. 1.
" The Chemical Age," Vol. 38, Nos. 956–60.
" Experimental Station Record," Vol. 77, No. 5.
" Forschungen und Fortschritte," Vol. 13, Nos. 31–33.
" Genetics," Vol. 22, No. 6.
" Indian Forester," Vol. 63, No. 12.
" Indian Forest Records," Vol. 3, No. 3.
" Indian Journal of Agricultural Science," Vol. 7, No. 5.
" Journal of Agricultural Research," Vol. 55, Nos. 6 and 7.
" The Philippine Agriculturist," Vol. 26, No. 6.
" Journal of Chemical Physics," Vol. 5, No. 11.
" Journal de Chemie Physique," Vol. 34, No. 10.
" Journal of the Institute of Brewing," Vol. 43, Nos. 10 and 11.
" Journal of Nutrition," Vol. 14, No. 5.
" Journal of Research," National Bureau of Standrads, Vol. 18, No. 5.
" Journal of the Royal Society of Arts," Vol. 85, Nos, 4431–35,

" League of Nations : Bulletin of Health Organisation," Vol. 6, No. 3.
" Medico-Surgical Suggestions," Vol. 6, No. 11.
" Nature," Vol. 140, Nos. 3547–50.
" Nagpur University Journal," Nos. 1 and 2.
" Russian Journal of General Chemistry," Vol. 69, Nos. 9–17.
" Review of Applied Mycology," Vol. 16, Nos. 9 and 10.
" Research and Progress," Vol. 3, No. 6.
" Science and Culture," Vol. 3, Nos. 4 and 5.
" Sky," Vol. 2, No. 1.
" The Indian Trade Journal," Vol. 126, Nos. 1638–41.
" Transactions of the Faraday Society," Vol. 33, No. 199.

Catalogues.

" Dexræ Industrial X-Ray Unit " (Adam Hilger, Ltd., London).
" Catalogue No. 6 " (Verlag von Gustav Fisher in Jena).
" Monthly List of Books on Natural History and Science " (Wheldon & Whesley).

ACADEMIES AND SOCIETIES.

National Institute of Sciences of India :

November 6, 1937 (Meeting held in the Physics Lecture Theatre, University Buildings, Delhi).—M. ISHAQ : *The O-O-Band of OD.* T. S. WHEELER : *The theory of liquids.* H. S. PRUTHI AND E. S. NARAYANAN : *A study of the behaviour of some common varieties of sugarcane with reference to the attack of borers.* D. S. KOTHARI : *Joule-Thomson effect and adiabatic changes in degenerate gas.* B. RAMAMURTI : *The chemical fixation at low temperature and its significance in agriculture.* M. N. SAHA AND K. B. MATHUR : *The propagation of electromagnetic waves through the atmosphere.* B. N. SRIVASTAVA : *Joule-Thomson expansion of a non-degenerate gas.*

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Indian Academy of Sciences:

November 1937. SECTION A.—S. R. SAVUR : *Evaluation of* $I_\beta\ (n-r, r+1)$. R. SAMUEL : *An Energetical Interpretation of the Semipolar Double Bond.*—Based on a number of experiments on the photo-dissociation of inorganic molecules, it is shown, that the essential features of the conception of a semi-polar bond can be retained as far as chemical reactivity is concerned, without introducing this second variety of covalency for such molecules. N. R. TAWDE AND D. D. DESAI : *Role of Argon in the Production of Swan Bands.*—A systematic study has been made of the intensity changes that take place in the Swan system by the gradual addition of argon to a discharge tube of ' H ' pattern having a capillary tube and fitted with carbon electrodes. R. K. ASUNDI AND S. MUJTUBA KARIM : *On the Emission Spectrum of* $SiBr_4$.—The spectrum is studied under different conditions of the flowing vapour and with condensed and uncondensed discharge. The nature of the spectrum undergoes certain radical changes under varying conditions of the flowing vapour. R. D. DESAI AND S. A. HAMID : *Heterocyclic Compounds. Part V. Synthesis of 2-Methyl-6-ethyl-7-hydroxy-chromone and its Derivatives.*—Kostanecki reaction has been applied to 2 : 4-dihydroxy-5-ethylacetophenone to prepare 7-acetoxy-6-ethyl-3-acetyl-2-methyl chromone and its derivatives. S. CHOWLA : *On a Trigonometric Sum.* A. L. SUNDAR RAO : *Photo-decomposition and Absorption Spectrum of Potassium Permanganate.*—It is found that while photo-decomposition increases slightly with frequency, there is no strongly selective wave-length.

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SECTION B.—S. A. AKTHAR : *Report on Some Nematode Parasites of Kabul, with description of New Species.*—One new species of the genus *Ascardia* Dujardin, 1845, one of the genus *Subulura* Molin, 1860, and one of the genus, *Tachygonetria* Wedl, 1862, have been described. MAKUND BEHARI LAL : *Studies on the Trematode Parasites of Birds.*—Two new forms coming under the sub-family Bilharziellinæ Price, 1929, have been described ; owing to certain peculiar characters presented by them, an emendment of the sub-family diagnosis is necessitated. N. KESHAVA PANIKKAR AND R. GOPALA AIYAR : *The Brackish-water Fauna of Madras.*—Observations concerning 92 species of invertebrates and 50 species of vertebrates inhabiting the brackish-waters of the City of Madras, have been reported.

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Meteorological Office Colloquium, Poona:

November 9 and 16, 1937.—DR. C. W. B. NORMAND : " *Morgule's* work on the theory of storms" :—He explained how the main results regarding energy changes can be obtained graphically by the use of indicator diagrams like tephigrams.

Errata.

Vol. VI, No. 5, November 1937.

(1) Contribution entitled "The Thermodynamics of Duststorms" :

Page 211, Column 1, line 52, *for* "15 hours 38 minutes" *read* "15 hours 15 minutes".

(2) Contribution entitled "A Convenient and Rapid Method for Determining Compressibilities of Gases and Vapours" :

Page 214, Column 2, last line, *for* "[2] K. L. Ramaswamy, *ibid.*, 1936, **4**, 108–33" *read* "[2] K. L. Ramaswamy, *Proc. Ind. Acad. Sci.*, A, 1936".

(3) Contribution entitled "An Indirect Method of Estimating Cocaine in Mixtures of Cocaine and Novocaine" :

Page 220, Column 1, line 17, *for* "Sodium nitrate" *read* "Sodium nitrite".

1923-37.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the " Current Science " Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.